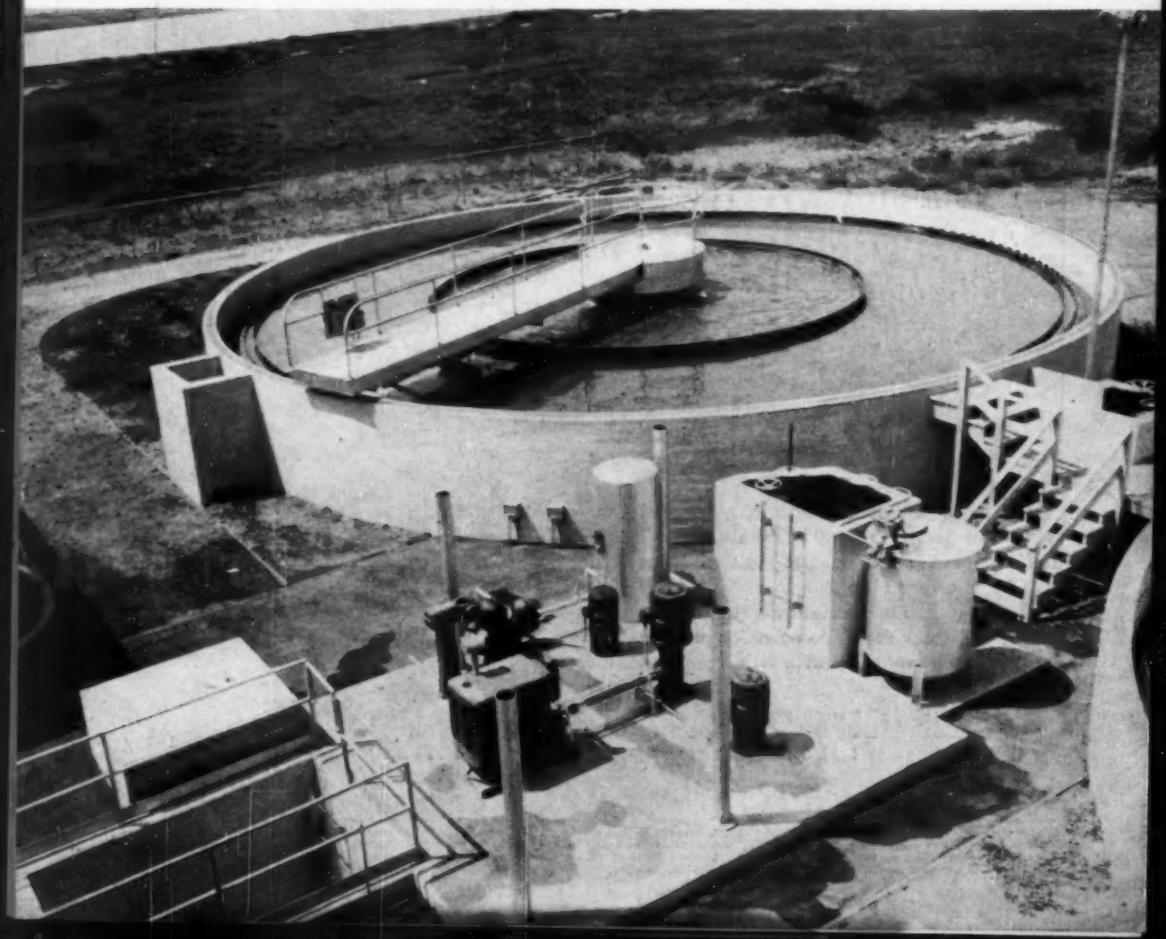
Vol. 37 No. 2 FEBRUARY, 1950

WATER & SEWAGE WORKS

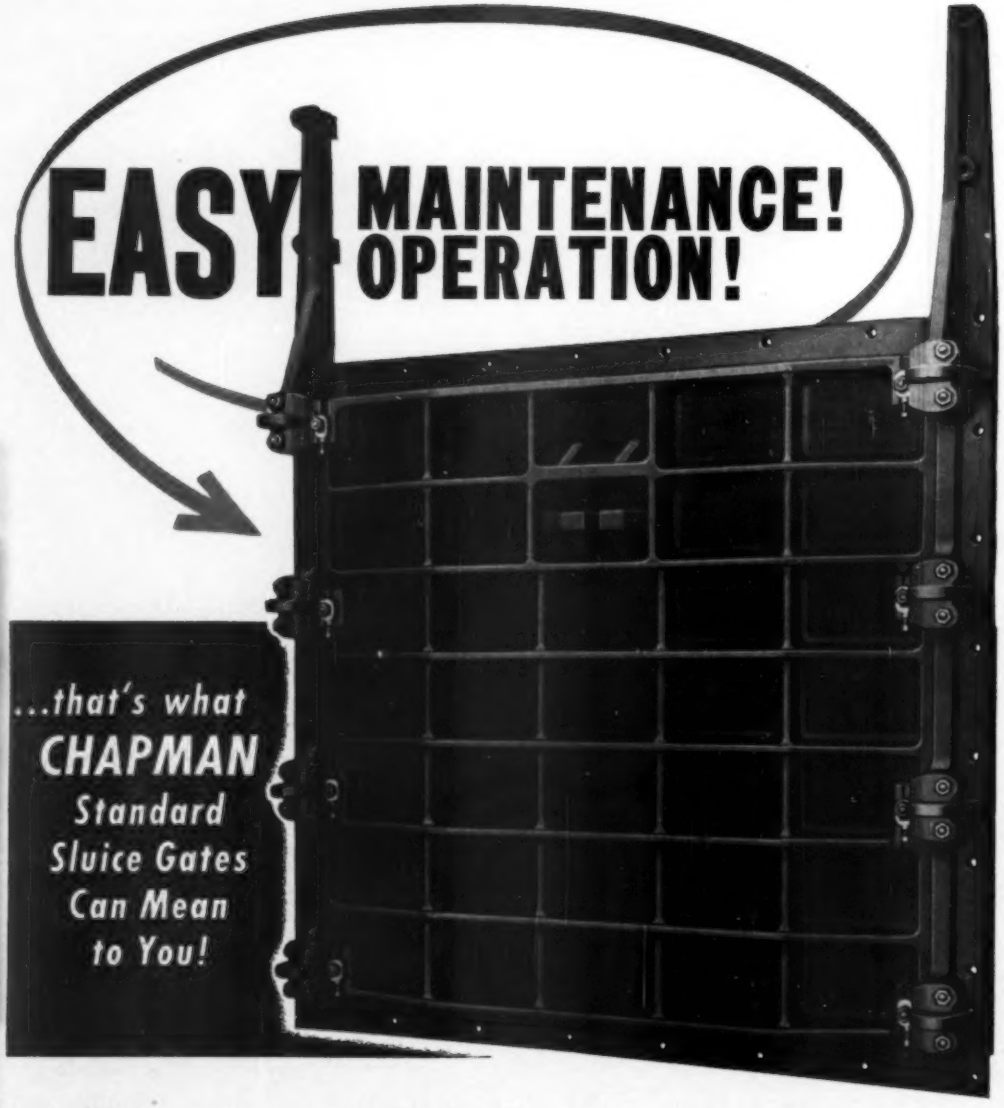
WATER SUPPLY SEWAGE DISPOSAL

INDUSTRIAL WASTE TREATMENT

CHULA VISTA'S NEW DUAL STAGE BIO-OXIDATION PLANT



EASY MAINTENANCE! OPERATION!



...that's what CHAPMAN Standard Sluice Gates Can Mean to You!

You'll find Chapman has designed these sluice gates with your problems in mind. That's why each one is standardized throughout . . . why stems and couplings are completely interchangeable in the field without alterations. What's more, there's no operation problem for they can be supplied with either manual, hydraulic cylinder or motor operating control. Available in a complete line to meet all usual conditions, these Chapman Sluice Gates can also be supplied in special patterns. It will pay you to write today for Bulletin No. 25.

THE CHAPMAN VALVE MFG. CO.
INDIAN ORCHARD, MASSACHUSETTS

WATER AND SEWAGE WORKS. Reg. U. S. Patent Off. February, 1950. Volume 97. Number 2. Published monthly by Gillette Publishing Co., at 404 North Wesley Ave., Mount Morris, Ill. Per copy, 25c; Subscription rate: United States, $2.00 per year; Canada, $2.00 per year; Foreign, $3.00 per year. Entered as second class matter March 4, 1949, at the post office at Mount Morris, Illinois, under Act of March 3, 1879. Executive and business offices, 22 W. Maple St., Chicago 10, Illinois. Editorial office, 155 E. 44th St., New York 17, N. Y.

ARE YOU LOSING AN ADEQUATE WATER SUPPLY THROUGH NEEDLESS WASTE?

WRITE FOR THIS PORTFOLIO OF EDUCATIONAL AIDS

REPRINTS OF PRIZE-WINNING ESSAYS
on the advantages of 100% metering
NEWS
NEWS
PUBLICITY STORIES
on meters and the advantages of meter ing for release to local newspaper
HOW WATER SUPPLY IS WASTED
WATER WASTE POST CARDS
Illustrated to show how water is wasted through leaks. Cuts available
METERING CASE HISTORIES
CASE HISTORIES
of actual "before and after" metering experiences in municipalities of varying size

TO CONSERVE WATER... METER ALL SERVICES

The nationwide water shortage has been widely publicized. Never before are so many people water-conscious. If your system is not 100 per cent metered you know that much water is being wasted. Now is the time to advocate metering to your consumers and municipal officials. You'll do yourself and the community a service. To help you "sell" this idea we have prepared a complete portfolio of factual data on how a community is benefited by metering all services. Write for it today—no obligation involved.

Pittsburgh Equitable Meter Division
ROCKWELL MANUFACTURING CO.
Pittsburgh 8, Pa.

Atlanta Boston Chicago Columbus Houston
Kansas City Los Angeles New York
Pittsburgh San Francisco Seattle Tulsa

What can research do for a specification product?

We manufacture a "specification" product—cast iron pressure pipe. It is purchased under standard specifications set up by engineering organizations representing users of the product, consultants and manufacturers. Meet the specifications and the customer is satisfied. The question is whether the manufacturer should be satisfied.

About 20 years ago we decided to find out what research could do for a "specification" product. The function of Industrial Research was then, as it is now, to develop a better product at the same, or if possible, at lower cost. We built and equipped a Research Laboratory.

What research has since done for our product is a result best known to our customers! After all, specifications only establish a "floor" beneath which quality standards must not fall. Through research we have steadily elevated those standards and, through quality control, have seen to it that they are adhered to.

Progress made by individual companies eventually leads to higher standards which must be met by all makers of the product. And progress in the production of cast iron pressure pipe is important to water, gas and sanitation utilities as well as to the public they serve. The key to such progress is Research.

To further our Research program we recently dedicated a new, even larger and finer research laboratory and developmental foundry at our plant and main office in Burlington, New Jersey.

U.S. cast iron PIPE

U.S. PIPE & FOUNDRY CO., GENERAL OFFICES, BURLINGTON, N. J.

America's largest producer of cast iron pressure pipe

WATER & SEWAGE WORKS

WATER SUPPLY—SEWAGE DISPOSAL—INDUSTRIAL WASTE TREATMENT

E. S. GILLETTE, Publisher

L. H. ENSLOW, Editor

COMING!

"Headaches, Hunches & Hard Work"

Constitutes a few pages from the experiences, the life and the philosophy of a self-made water superintendent who has had more than one man's share of varied experiences. Both interesting and entertaining reading, this series reveals many helpful hints and emergency procedures. Watch for the story of—

M'KEAN MAFFITT, Hon. Member A.W.W.A.,
Former Supt. of Water and Sewage, Wilmington, N.C.

Some New Concepts in Sewage Treatment

Will be unfolded in a series of papers reporting on a basic study of the biochemical and physical mechanisms of sewage treatment and of the criteria by which the performance of these mechanisms may be measured and evaluated. These articles introduce a new and simplified approach to the evaluation of plant unit and process efficiency. This series is the contribution of 2 top flight investigators—

W. WESLEY ECKENFELDER, JR., and JOHN W. HOOD,
Chemist and Sup't., Sewage Treatment Wks., Ridgewood, N.J.

Determination of Metals in Industrial Wastes

Is often very important in industrial waste studies, but "Standard Methods" are not always suitable without modifications. Modified methods for iron, copper, chromium, vanadium, and cyanide are presented by—

H. GLADYS SWOPE (and others),
Formerly, Allegheny Co. San. Authority.

Water Treatment Experiences

A well qualified chemist and superintendent of water treatment with varied experience and keen observation sets forth some of his "Experiences in Water Treatment" in a series of articles, designed to be helpful to the less experienced and interesting to all. The author of this new series, which began in our January issue, is—

ALBERT H. ULLRICH, Supt.,
Water & Sewage Treatment, Austin, Tex.

Industrial—Municipal Cooperation

Is the foundation of a successful program for the disposal of industrial wastes via a municipal sewer system. Such is the theme of an article by—

W. H. WISELY, Executive Secy.,
Federation of Sewage Wks. Assns.

The Foreman's Stake in Safety

Is more than academic; it is of vital importance to the operation of water and sewage plants, if they are to be operated properly. Factors which affect safe or unsafe practices, and ways and means of decreasing hazards and improving safety are presented in this article by—

HAROLD F. WEBB, Gen. Safety Dir.,
Amer. Water Works Co., Inc., New York.

High Rate Bio-Oxidation Tests

Have been made on a pilot plant scale at Elmhurst, Ill., in which a modified Infilco "Accelator" employing a moderate air input was employed. Results of the tests are reported by—

A. A. KALINSKE, Hydraulic Engr.,
Infilco Inc., Chicago.

Operation of Small Water Plants

Is the general title of a new series of articles by the same author whose series on the "Operation of Small Filtration Plants" we published during the past year. The author is—

A. E. CLARK, Gen'l Mgr.,
Nashville (Tenn.) Suburban Utility Dist.

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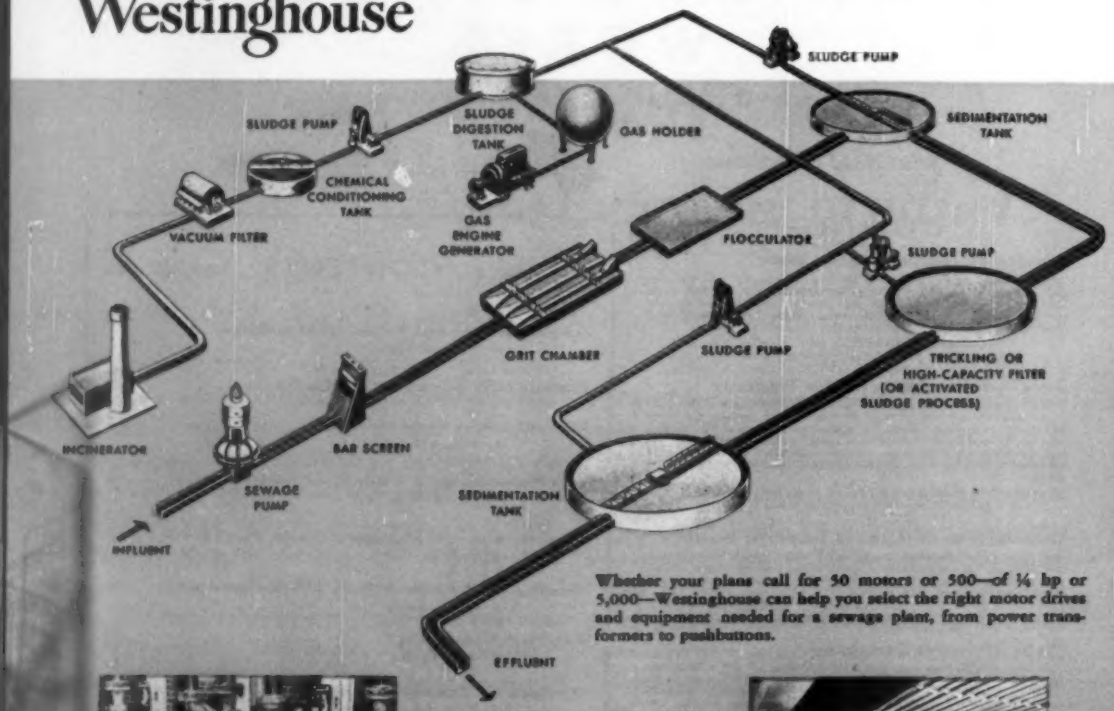
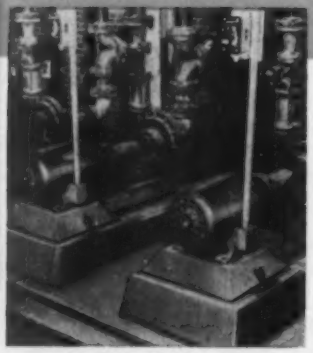
YOU CAN BE **SURE**.. IF IT'S

Westinghouse



Whether your plans call for 50 motors or 500—of ¼ hp or 5,000—Westinghouse can help you select the right motor drives and equipment needed for a sewage plant, from power transformers to pushbuttons.



Life-Line motors which need no lubrication being used on a typical pumping application such as encountered in most sewage plants.

This control center provides a central location for operating all pump, blower and miscellaneous motor drives (600 volts and below) for the surrounding area.

Westinghouse Indoor Metal-clad Switchgear (2,300 volts) for feeder circuits to main pump motors. It's assembled at the factory and installed as a packaged unit to provide protection for vital equipment.

Two Westinghouse Two-speed Vertical CS Motors driving main sewage disposal pumps (one 350/160 and the other 250/100 hp). For emergency conditions, motors have a high-speed rating, can handle 300% of normal capacity.

UNIT ELECTRICAL RESPONSIBILITY

plus practical application help

Satisfactory operation of your sewage plant depends, in a large part, on the electrical equipment which powers and controls its drives. Consider the advantages to you of obtaining all this electrical equipment from one reliable source that will provide you a well co-ordinated, dependable and economical installation based on a practical understanding of sewage plant problems.

Westinghouse provides that source. Our Consulting and Application Engineers have had extensive experience in applying electrical equipment to sewage plants. They will recommend the right equipment for every step in your sewage treating process.

This unit responsibility does not cease with the installation. Our nationwide chain of Manufacturing and Repair Plants and Renewal Parts Warehouses provide you at all times with top-flight maintenance service.

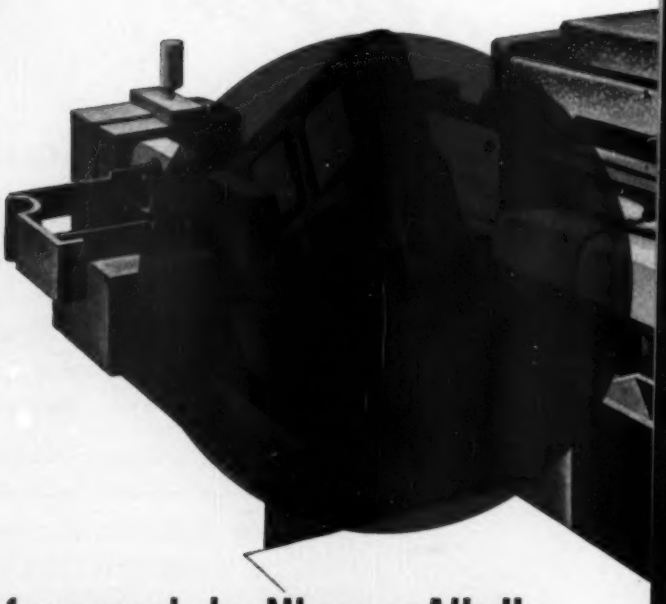
Unit electrical responsibility means economy and efficiency for you. Call your nearest Westinghouse Office or write Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pennsylvania.

J-94795

Westinghouse

as you were in 1900

Many soap-making operations were done by hand; so were some of the processes involved in paper, textile and glass manufacturing as well as water purification and sewage treatment.



as you are today

Sanitary, efficient machine operations replace the old hand processes in soap manufacture.

...with 50 years of research by Niagara Alkali

Gigantic kettles four stories deep... capacities as high as 175 tons... these are the superlatives in which soap-makers are planning—and working —today. Every step in soap manufacture is absolutely controlled to assure a uniform and superior product.

Niagara Alkali, now observing its 50th anniversary, is likewise able to assure the uniformity and superiority of its products—the result of continuous research to achieve product control and efficiency. The success of this research is reflected in Niagara's ability to serve many fields well: paper, soap, glass, textiles, sewage treatment, water purification and others.

NIAGARA ALKALI COMPANY

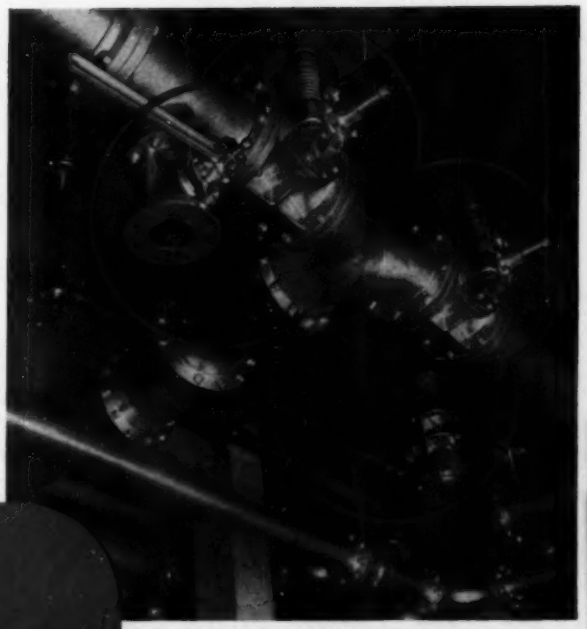
60 East 42nd Street, New York 17, N. Y.

Liquid Chlorine • Caustic Potash • Carbonate of Potash • Paradichlorobenzene • Caustic Soda • NIALK TRICHLORethylene

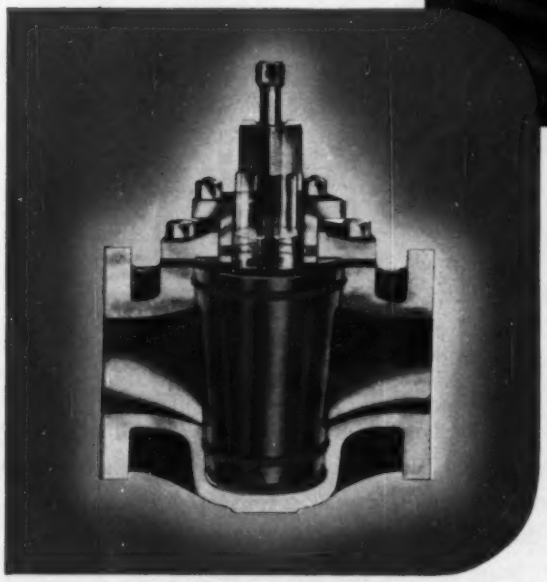
The preferred valves for

SEWAGE TREATMENT PLANTS

- **Tapered lubricated plug**
- **Pressure-sealed against leakage**
- **Seat never exposed to line**
- **Corrosion and erosion-resistant**
- **Quarter-turn, easiest operation**



Nordstrom valves on sludge feeders in vacuum filter room



Straightway and Multiport types
Wrench, gear, cylinder and motor operation

LONGEST LIFE *handling sludge*

Nordstrom lubricated valves are recognized by sewage engineers as the *one* type of valve perfectly suited to conditions encountered in sewage treatment. They are widely used on sludge lines, pump suction and discharge, lateral air lines, grit chamber drain lines, gas and water lines.

The tapered plug rotates on a film of pressurized lubricant so that leakage is prevented. The plug can be jacked if it becomes too tight merely by turning the external lubricant screw. The seat is always covered; never exposed. Grit and corrosive contaminants are effectively prevented from contacting the seat. The passageway is flush, with no cavities or crevices. A quarter-turn full opens or closes the valve.

Rockwell *Hypermatic* lubricant (Patents applied for) now gives Nordstrom valves *automatic lubrication*. The most outstanding development in 30 years of valve progress. Reduces maintenance costs to a minimum. Ask for Bulletin V-211.

Keep upkeep down

Nordstrom Valves

NOW AUTOMATICALLY LUBRICATED WITH Hypermatic

TRADE MARK

***Nordstrom Valve Division*—ROCKWELL MANUFACTURING CO.**
400 North Lexington Avenue, Pittsburgh 8, Pa., Offices in all principal cities

Export — Rockwell Mfg. Co., International Division, Empire State Building, New York 1

Without shock strength—or, for that matter—without all of the strength factors listed opposite—no pipe laid 100 years ago in *city streets* would be in service today. But, in spite of the evolution of traffic from horse-drawn vehicles to heavy trucks and buses—and today's vast complexity of subway and underground utility services—cast iron gas and water mains, laid over a century ago, are serving in the streets of more than 30 cities in the United States and Canada. Such service records prove that cast iron pipe combines all the strength factors of long life with ample margins of safety. No pipe that is provably deficient in any of these strength factors should ever be laid in city streets. Cast Iron Pipe Research Association, Thos. F. Wolfe, Engineer, 122 So. Michigan Ave., Chicago 3.

CAST IRON PIPE

Strength factors of Long Life !

No pipe that is provably deficient in any of these strength factors should ever be laid in city streets

SHOCK STRENGTH

The toughness of cast iron pipe which enables it to withstand impact and traffic shocks, as well as the hazards in handling, is demonstrated by the Impact Test. While under hydrostatic pressure and the heavy blows from a 50 pound hammer, standard 6-inch cast iron pipe does not crack until the hammer is dropped 6 times *on the same spot* from progressively increased heights of 6 inches.

CRUSHING STRENGTH

The ability of cast iron pipe to withstand external loads imposed by heavy fill and unusual traffic loads is proved by the Ring Compression Test. Standard 6-inch cast iron pipe withstands a crushing weight of more than 14,000 lbs. per foot.

BEAM STRENGTH

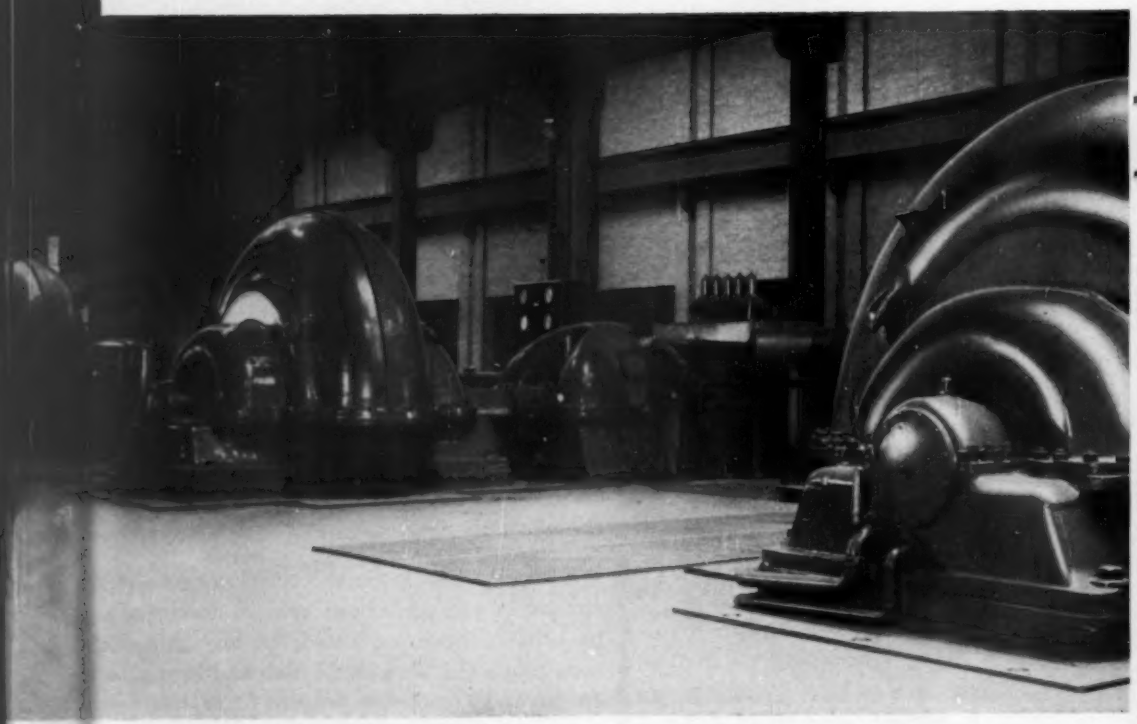
When cast iron pipe is subjected to beam stress caused by soil settlement, or disturbance of soil by other utilities, or resting on an obstruction, tests prove that standard 6-inch cast iron pipe in 10-foot span sustains a load of 15,000 lbs.

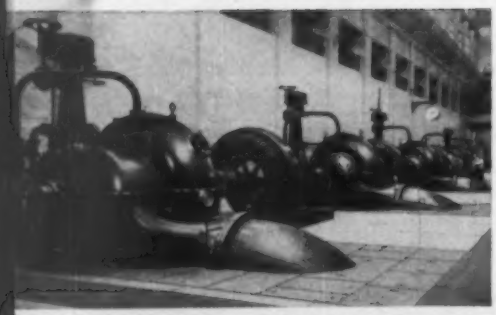
BURSTING STRENGTH

In full length bursting tests standard 6-inch cast iron pipe withstands more than 2500 lbs. per square inch internal hydrostatic pressure, which proves ample ability to resist water-hammer or unusual working pressures.

SERVES FOR CENTURIES

Chicago Expands





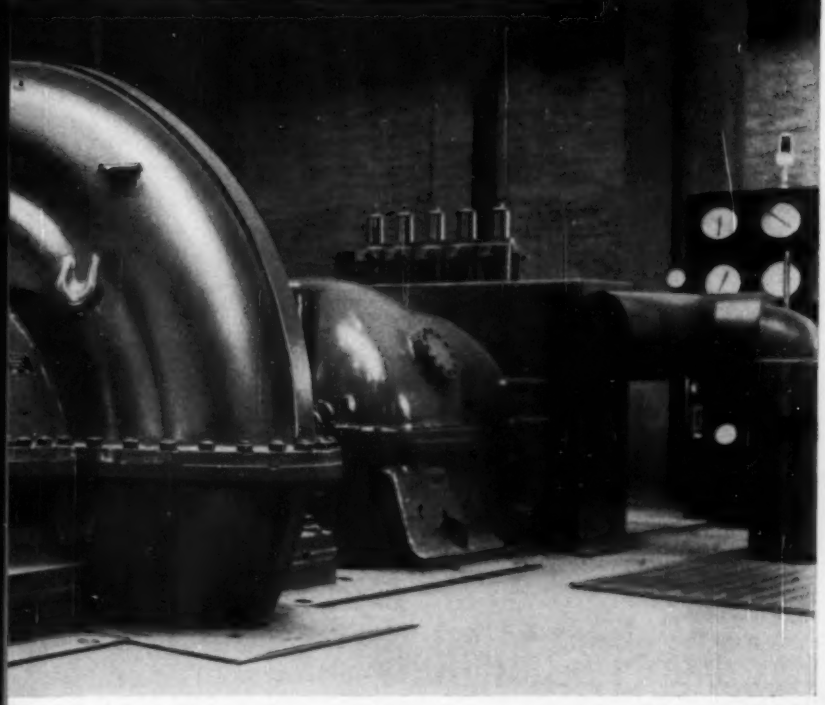
SEVEN Allis-Chalmers motors and pumps handle sewage in Chicago's West Side Treatment Plant.

West-Southwest treatment plant adds two Allis-Chalmers Blower-Turbine Units

Builders of the World's Widest Range of Public Works Equipment

ALLIS-

SEWAGE TREATMENT CAPACITY!



THE WORLD'S LARGEST sewage treatment plant handles sewage equivalent to the waste disposal of more than 3 million population.

Using the activated sludge process, a total air output of 595,000 cfm is required; of which 370,000 cfm is furnished by three Allis-Chalmers blowers driven by A-C condensing steam turbines, with A-C surface condensers. The two newest Allis-Chalmers units were installed in 1949.

Throughout Chicago's vast Public Works System you will find a wide variety of Allis-Chalmers equipment . . . turbines, motors, condensers, pumps, blowers, and electrical control and distribution apparatus.

Call on *Specialized* Experience!

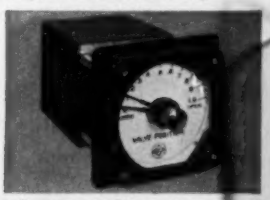
Because Allis-Chalmers builds the world's widest line of public works equipment, it can help you with your equipment problems . . . whether your city is large, medium or small. For the complete A-C Public Works Equipment story, write for bulletin 25B6607 or see your nearest A-C representative. A-2940

ALLIS-CHALMERS, 1192A SO. 70 ST.
MILWAUKEE, WIS.

News Notes

for Water and Sewage Works Men

INCREASED MECHANIZATION and simpler, more positive control of plant operations is today's goal in the design of water and sewage works. Below is a typical diagram, using Allis-Chalmers *Remote Control and Indicating System* that proves how such simplification can be secured.



Indicating meter for mounting on panel control board.

In a system like this, a single operator at a panel board can accurately control (±1%) such factors as valve and gate openings, water levels, etc. and receive indications of their exact positions. The system can also be used for order telegraph.

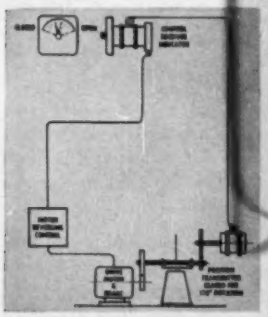


Diagram of typical Allis-Chalmers Remote Control and Indicating System.

For complete information on Allis-Chalmers DC Positioner and other specialized controls for public works, write for Bulletin 14B6641 or call your nearest A-C representative.

A-C CHALMERS

ALLIS-CHALMERS

"Boy! Was that Commissioner impressed!"

"Said he didn't think it was possible to raise a gate so easy. Seems that in his town's plant they're forever having trouble with gates sticking and stems breaking. No wonder. On some of his gates there's forty tons' pressure pushing a rusty gate against rusty facing strips. That's friction you just can't beat.

"I told him our Everdur* equipment won't stick because it never rusts. When he said they can't afford to use Everdur, I told him he can't afford *not* to. Proved it, too! Showed him that the little extra it cost was only a fraction of what they were spending on replacements . . . replacements they'd never have had to make if they'd used Everdur in the first place. The Commissioner said he guessed I was right.

"Smart man, that Commissioner."

*Reg. U. S. Pat. Off.

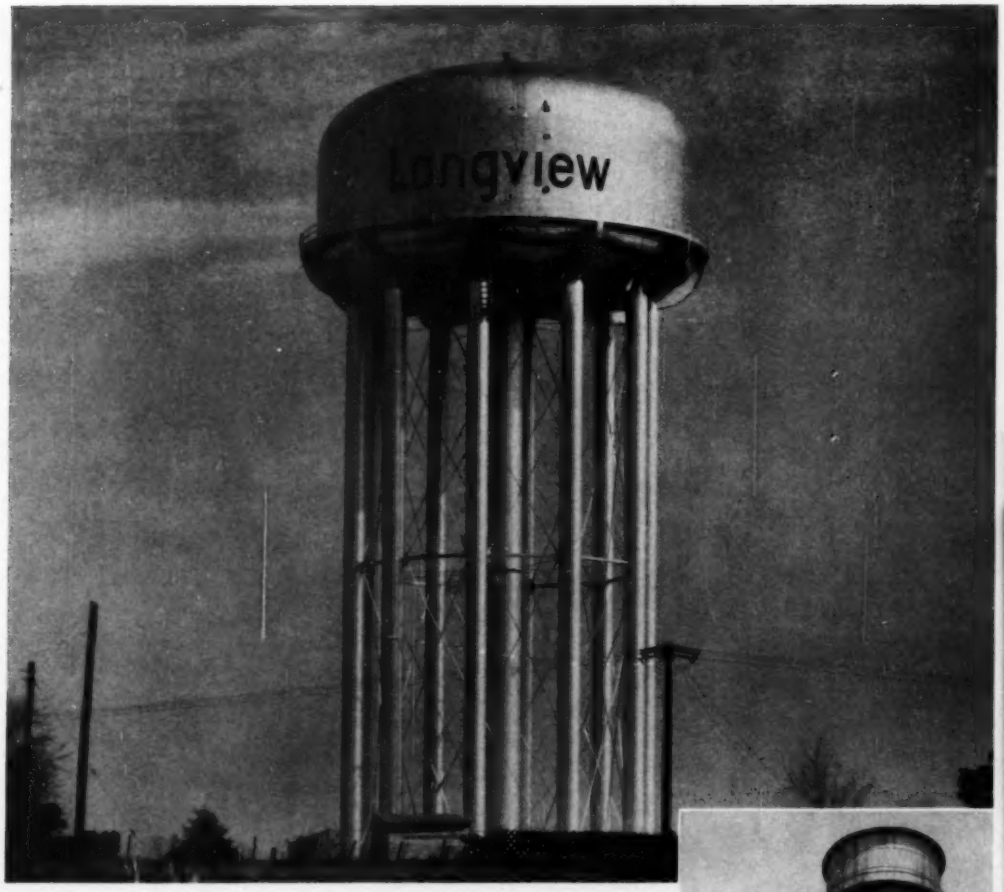
Corrosion is the enemy you can lick by fabricating your equipment with Everdur . . . Anaconda's Copper-Silicon Alloys. Everdur combines the corrosion resistance of copper with high tensile strength. It's available in all wrought commercial shapes; also in casting ingots. It is easy to weld and easy to fabricate.

May we send you more information on Everdur? Do you have a problem on which we can give you technical counsel? Just write to The American Brass Company, Waterbury 20, Connecticut. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

Where corrosion resistance counts—use Everdur . . . .

ANACONDA

COPPER-SILICON ALLOYS



with an eye for improvement

Longview adds Third Horton Tank

When Longview, Texas, outgrew its water system, the city engineers logically decided to improve water storage facilities first. The total elevated storage capacity was increased to 1,350,000 gallons by adding the 1,000,000-gal. Horton tank shown above. The other 350,000 gals. of elevated storage is provided by the ellipsoidal bottom tanks shown at the right. The 200,000 gal. tank in the background was erected in 1930 and the 150,000-gal. tank in the foreground was built in 1914.

Longview is another of the progressive cities that has answered immediate problems with a solution that has a future—modern elevated storage. This trend is continuing because elevated storage usually provides uniform water pressure during peak-loads, adequate reserve supply during power failure, lower pumping costs, and lower insurance rates. Find out from our nearest office how elevated tanks can improve water service in your community.

CHICAGO BRIDGE & IRON COMPANY

Atlanta 3 ..... 2181 Healey Building	Detroit 26 ..... 1551 Lafayette Building	Philadelphia 3 ..... 1644—1700 Walnut Street Building
Birmingham 1 ..... 1586 North Fiftieth Street	Houston 2 ..... 2115 National Standard Building	Salt Lake City 4 ..... 560 West 17th South Street
Boston 10 ..... 1049—201 Devonshire Street	Havana ..... 402 Abreu Building	San Francisco 11 ..... 1283—22 Battery Street Building
Chicago 4 ..... 2199 McCormick Building	Los Angeles 14 ..... 1555 General Petroleum Building	Seattle 1 ..... 1350 Henry Building
Cleveland 15 ..... 2262 Guildhall Building	New York 6 ..... 3190—165 Broadway Building	Tulsa 3 ..... 1646 Hunt Building

Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PENNSYLVANIA

UNINTERRUPTED FULL FLOW

FULL PIPE AREA CYLINDRICAL PLUG...

Stands alone in its ability to minimize turbulence and change of velocity, without use of larger-than-pipe-size valves. Quick operation, if needed, no wedging, lubricated for long life and corrosion protection...why anything but an A.C.F. Lubricated Plug Valve.

CYLINDRICAL a.c.f. FULL PIPE AREA PLUG VALVES LUBRICATED

Representatives in more than 50 Principal Cities.

A.C.F. Valves are ideal for sewage operations. Ask for catalog 4-WS—American Car and Foundry Company, Valve Division, 30 Church St., New York 8, N.Y.

removed under pressure

This pipe section was cut, under pressure, from a 48" main without shut-down or other interruption to service. The operation was performed in the course of inserting a gate valve in a 48" cast iron main, in the distribution system of the Water Bureau, City of Philadelphia, Pa.

Gate valves can be inserted under *pressure* by SMITH in cast iron, asbestos—cement or steel water mains, sizes 4" and larger, without shutting off service or dewatering the line.

30

GATE VALVES
CHECK VALVES
FIRE HYDRANTS
INSERTING VALVES
TAPPING SLEEVES AND VALVES
WATER SERVICE BRASS GOODS

THE A. P. SMITH MFG. CO.
ESTABLISHED 1896
EAST ORANGE, NEW JERSEY

FLOOR STANDS
INDICATOR POSTS
TAPPING MACHINES
INSERTING MACHINES
PIPE CUTTING MACHINES
CORPORATION TAPPING MACHINES

Two 45' PFT Floating Covers at Stevens Point, Wisc., Consoer, Townsend & Associates, Engineers.

UNLIKE a book, a digester tank is judged by its cover, as well as by what's under the cover. P.F.T. Floating Covers are soundly engineered and constructed to assure a long attention-free, service life. Here again, it's proper design based on long experience, for P.F.T. is pioneer of the floating cover. Literally, hundreds of installations all over the country have given continuous service for years.

P.F.T. Covers provide complete submergence of buoyant sewage solids, effective collection of sewage sludge gas, flexibility through operation either in series or parallel (where more than a single tank is involved) and complete digestion control regardless of what portion tank capacity is employed.

Used in conjunction with a P.F.T. Digester Heater and Heat Exchanger, P.F.T. Supernatant Control Equipment and P.F.T. Gas Safety Equipment, P.F.T. Floating Covers offer the maximum in efficiency and economy for population loadings of 500 to 5 million.

PFT **pacific flush tank co.**

Chicago (13) New York Los Angeles San Francisco
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Builders of Digester Heaters and Heat Exchangers, Gas Safety Equipment, Supernatant Liquor Selectors and Gauges, Rotary Distributors, Fixed Nozzle Filter Equipment and Air Diffusion Equipment. Write for Bulletins. Pacific Flush Tank Co., 4241 Ravenswood Ave., Chicago 13.

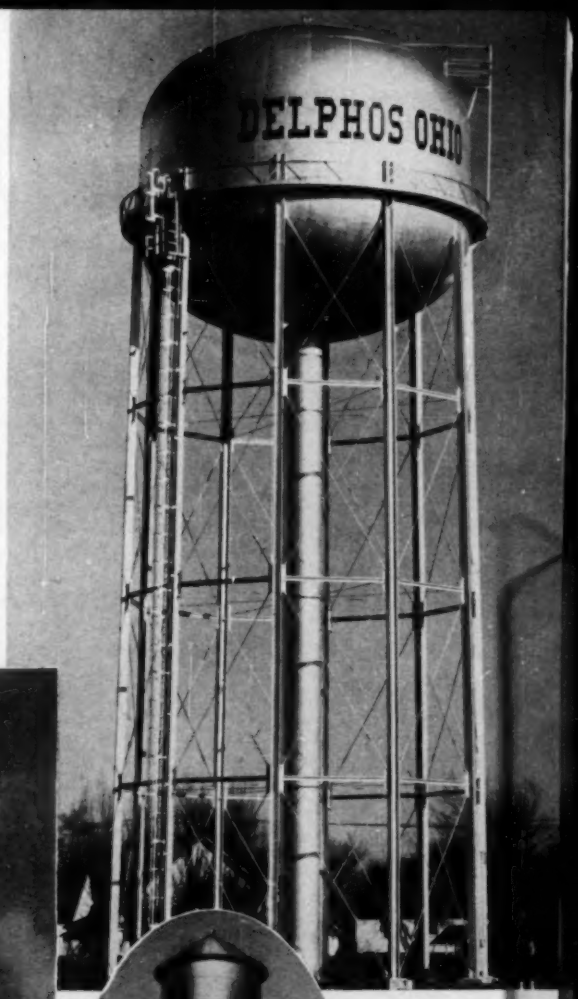
FIRST AND FOREMOST IN SEWAGE AND TRADE WASTE TREATMENT EQUIPMENT SINCE 1893

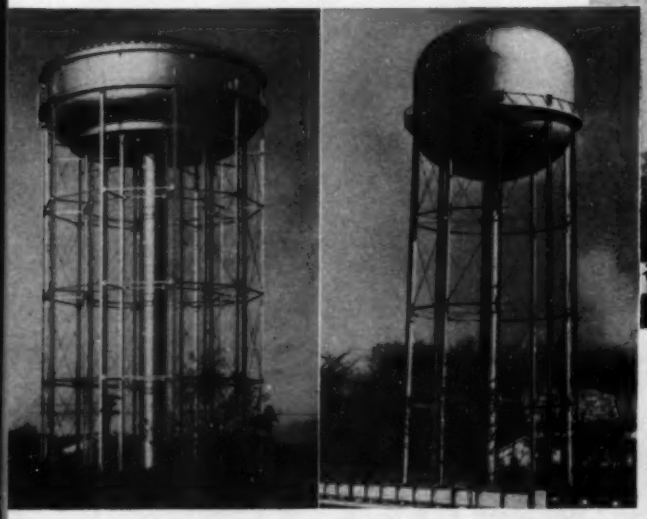
BEAUTY
EFFICIENCY
ECONOMY

FOR MUNICIPAL WATER STORAGE REQUIREMENTS

PITTSBURGH • DES MOINES

Elevated Steel Tanks





Match your specific water storage need with the right Pittsburgh-Des Moines Elevated Steel Tank! We will be happy to consult with you at any time, without obligation . . . meanwhile, write today for our comprehensive new Catalog: *informative, clear, complete!*

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NEW YORK	Room 918, 270 Broadway	DALLAS	1223 Praetorian Bldg.
CHICAGO	1232 First National Bank Bldg.	SEATTLE	926 Lane Street
	SANTA CLARA, CAL.	625 Alviso Road	

FOR WATER, STEAM, OR GAS LINES *not requiring use of "125-pound" valves . . . Crane recommends 25-Pound Iron Body Double Disc Gates with brass trim. Short and compact; occupy minimum space in pipe lines. Rated at 25 pounds steam; up to 50 pounds cold water. Flanged or hub ends. Sizes: 10-in. and larger. See your new Crane Catalog, p. 90-1.*

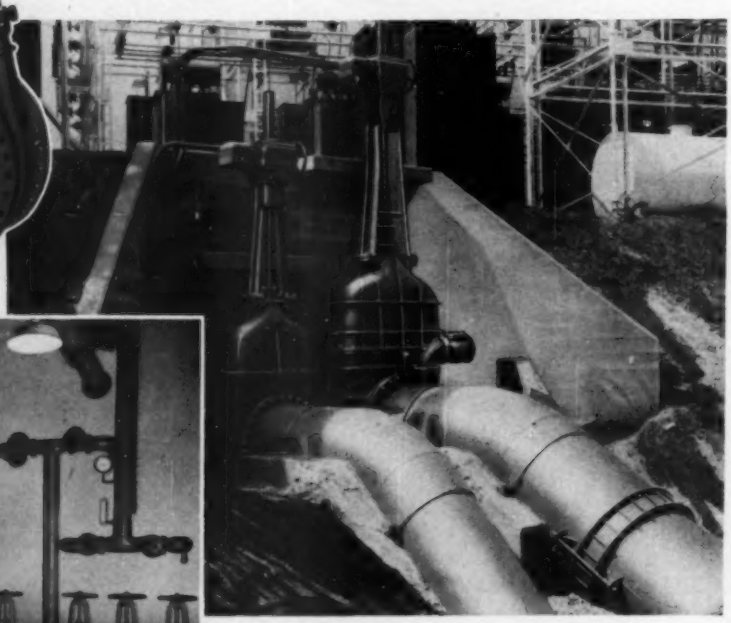
CRANE VALVES

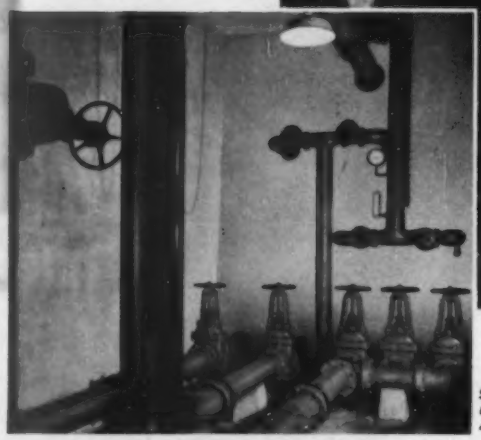
for better water service at lower cost

Can you always count on positive performance from valves in water and sewage services? Those valves used infrequently as well as those operated every day? You can when you equip with Crane. For Crane valves and fittings have a record for efficient performance under all operating conditions that is second to none.

With such a record it is obvious that maintenance, repair, and replacement costs will be held to the minimum. Today as always, Crane Quality in construction and materials is your assurance of valves that give long and dependable duty on any water service.

CRANE CO., 836 S. Michigan Ave., Chicago 5, Ill., *Nation-wide Service Through Branches and Wholesalers*





WATER SUPPLY LINES *at hydro-electric plant featuring Crane 36-in. and 42-in. motor operated double disc gate valves, check valve and flanged fittings.*

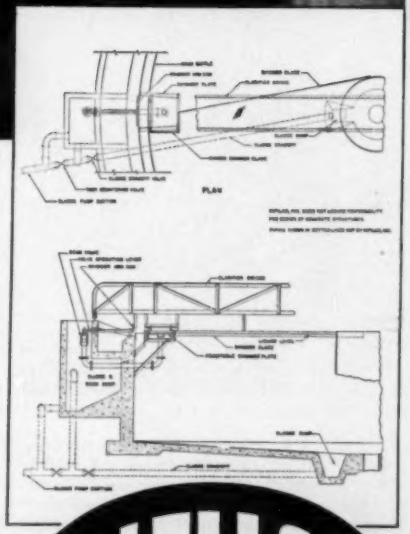
SEWAGE DISPOSAL PLANT *equipped with Crane 200-pound iron body double disc gate valves with cleanout, pipe, flanged fittings and chain wheel operators.*

VALVES · FITTINGS · PIPE

CRANE

PLUMBING AND HEATING

ODESSA, TEXAS, INSTALLATION OF INFILCO AUTOMATIC HYDRAULIC SKIMMER



Controlled Currents Remove Scum this New and Better Way!

INFILCO'S Automatic Hydraulic Skimmer introduces a *new principle* in scum removal. Now, the use of *controlled currents* brings a new high degree of efficiency to the disposal of surface scum in primary clarifiers. The heart of the scum remover is the scum discharge pipe which fits into the center of the skimmer plate located just below the liquid surface. Here, controlled currents are set up to remove surface scum. Removal occurs automatically once during each revolution of the sludge scraper assembly.

WRITE TODAY for Bulletin No. S 6000. It gives all the interesting facts concerning this better scum remover. Also complete information about Infilco's "quiescent clarification" . . the ultimate in effective sedimentation and sludge removal.

INFILCO

• BETTER WATER CONDITIONING AND WASTE TREATMENT SINCE 1894 •

INFILCO INC.

SALES OFFICES IN TWENTY SIX PRINCIPAL CITIES

WORLD'S LEADING MANUFACTURERS OF WATER CONDITIONING AND WASTE TREATING EQUIPMENT

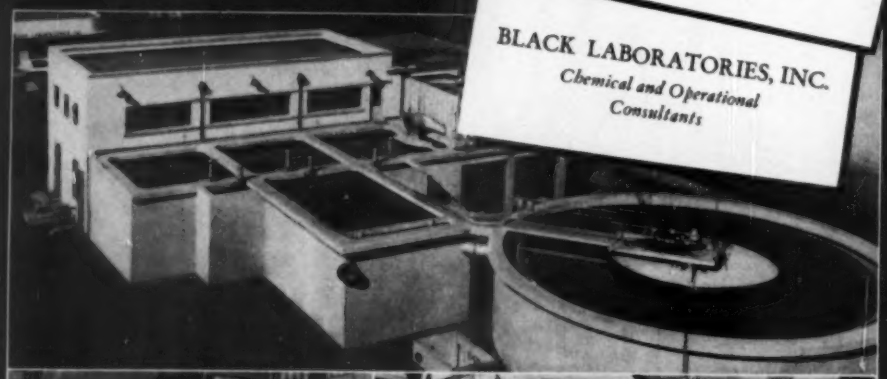
GAINESVILLE, FLORIDA

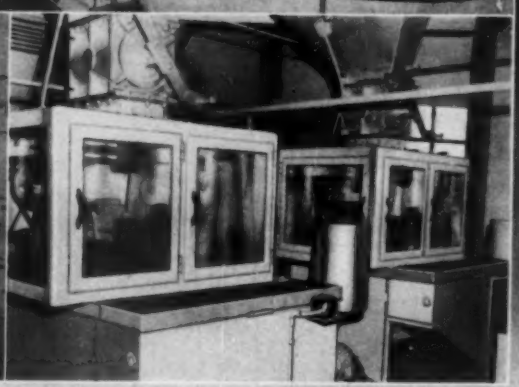
Water Treatment Plant

(Completed in 1948)

ROBERT AND COMPANY
& ASSOCIATES
Architects and Engineers

BLACK LABORATORIES, INC.
Chemical and Operational Consultants





A big advancement in Gainesville's water supply was brought to completion on December 6, 1948, when the first treated water was pumped from the new Treatment Plant into the city mains. Now the 25,000 residents of this city are assured a safe, potable water, free from water-borne organisms and organic color, and of greatly reduced hardness. Omega dry chemical feeders, lime slakers, and dust collectors, installed by J. A. Jones, contractors, of Charlotte, N. C., play an essential part in the operation of this efficient plant. An interesting innovation is the Omega Disc Feeder which introduces sodium fluoride into the water supply for the control of tooth decay. For Bulletins describing Omega equipment, address Omega Machine Co., (Division of Builders Iron Foundry), Providence 1, R. I.

Omega equipment furnished the Gainesville Water Treatment Plant:

- 2—Belt-type Gravimetric Feeders for Quicklime
- 2—Lime Slakers—250 lbs. per hr. capacity
- 1—Loss-in-weight Gravimetric Feeder for Alum
- 1—Loss-in-weight Gravimetric Feeder for Soda-ash
- 3—Dust Collectors
- 1—#46 Disc Feeder for Sodium Fluoride

THE LAST WORD IN FEEDERS

OMEGA

Lower Excavation Costs

Substantial savings in excavation costs are often possible with Transite* Sewer Pipe because of its high flow capacity. This often permits the use of flatter grades and shallower trenches. This is a particularly important advantage where the pipe must be laid at or below the ground water line or where rock excavation is involved.

As an alternate economy, designers may take advantage of Transite's high flow capacity by specifying smaller diameter pipe.

Other Transite Economies

Transite's long 13-foot lengths and light weight lower handling costs. And because there are fewer joints to assemble in the finished line, installation is faster, and more economical.

As a further economy, Transite's sleeve-type joints guard effectively against infiltration. This helps reduce the load on the treatment plant. Therefore, treatment costs are kept to a minimum—plant capacity is conserved for the increased loads incident to community growth.

Made of asbestos, cement and silica combined into a homogeneous material of great stability, Transite Sewer Pipe is corrosion-resistant both inside and outside. Tight joints safeguard against root trouble. And every Transite length is factory-tested for strength and uniformity. This adds up to low maintenance costs through the years.

For all the facts about Transite, send for brochure TR-21A. Address Johns-Manville, Box 290, New York 16, N. Y.

JM

*Transite is a Johns-Manville registered trade mark

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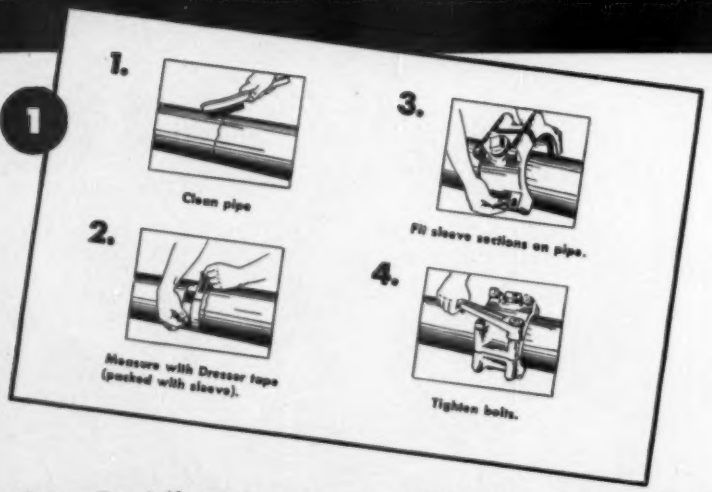
TRANSITE SEWER PIPE...

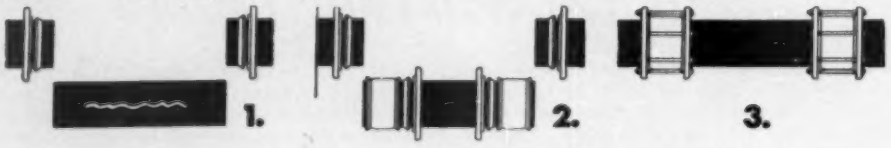
2 EASY WAYS to repair water lines



With a Dresser Repair Sleeve. On cast iron pipe, 4″ to 8″ in diameter, for splits, breaks or holes, use a Dresser Style 82 "Adjustable" Repair Sleeve. One man can make a permanent repair in a matter of minutes, using only a wrench. Sleeve is factory-assembled; no loose parts, no gaskets to cut and fit when seconds count, no caulking. The specially compounded Dresser gaskets afford a quick pack—a permanent seal.

Note: The Dresser Style 82 Repair Sleeve also offers the most convenient method for making a large tap off a small diameter main.

2



With Dresser Couplings. For breaks too long to be repaired with a sleeve, use Dresser Style 38 Couplings. Cut out a section of the pipe where the break occurs. Fit the couplings onto pipe ends. Put a new section in place. Bolt up the couplings. That's all there is to it. Dresser's resilient rubber gaskets assure a permanently tight repair . . . and guard against recurrence of the break by absorbing stresses and strains in the line.

Note: This same procedure can be followed for cutting a new line into an old one, for inserting a valve into a line and for solving similar problems.

DETAILED, FACTUAL LITERATURE on how Dresser products can solve your water line repair and coupling problems is yours for the asking. Write today.

DRESSER COUPLINGS and REPAIR PRODUCTS

Dresser Manufacturing Division, 59 Fisher Ave., Bradford, Pa. (One of the Dresser Industries) • In Texas: 1121 Rothwell St., Houston
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CLAY . . .

RAW STUFF OF THE *Only*

CORROSION-RESISTANT PIPE

Vitrified Clay Pipe is the only pipe offering complete protection against acids, alkalies, and chemicals. Proof? *There is no instance on record where a single length of Clay Pipe has ever worn out due to the action of a disintegrating agent.* This explains why 89% of America's sewerage lines are made of Vitrified Clay Pipe. On any sewerage or drainage project, be *sure* by specifying Vitrified Clay.

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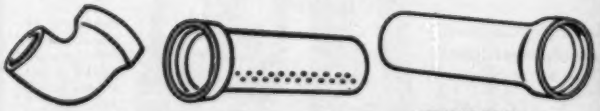
SPECIFY *Vitrified*

CLAY PIPE

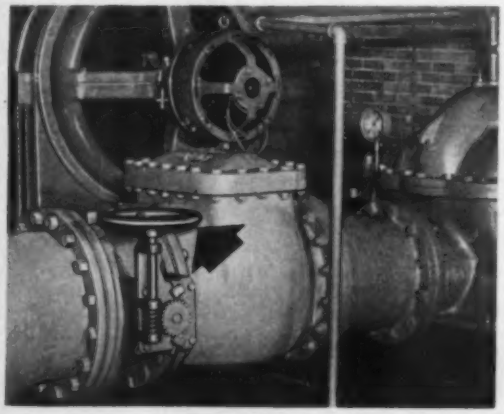


CLAY PIPE FITTINGS | **PERFORATED CLAY PIPE** | **STANDARD-STRENGTH CLAY PIPE**

C-150-1

R-S valvEvents

• EXCERPTS FROM THE R-S BOOK OF EXPERIENCE •



6 HANDWHEEL TURNS OPEN OR CLOSE VALVE

This quick closing feature is an important consideration in water pumping operations as illustrated above or any application where a battery of synchronous driven pumps discharges into a common header.

Normal procedure when starting a pump is to shut off the discharge valve until the pump has gained the desired speed. The valve is then opened gradually. Since it requires only a few seconds of an operator's time, this important operation is not likely to be neglected when R-S Valves are installed. Burned-out motors at start-ups can be practically eliminated.

R-S Valves show substantial savings in pumping power due to low pressure drop. Consider also the compact design, light weight and self-cleaning features.

Consult with your local R-S representative. Look for the address and phone number listed under "R-S Products, Valves" or write direct.

R-S PRODUCTS CORPORATION
Wayne Junction • Philadelphia 44, Pa.

Sectional view shows beveled vane of R-S Valve firmly seated at a 12½° angle. A metal-to-metal seat gives satisfactory commercial shut-off in many cases. Manual or automatic control available.

Drip tight or bubble tight closure can be obtained with a rubber seat. Under pressure, due to the 12½° angle of closure, the rubber yields both radially and longitudinally around the shaft-bosses and the periphery of the valve vane to insure positive shut-off.

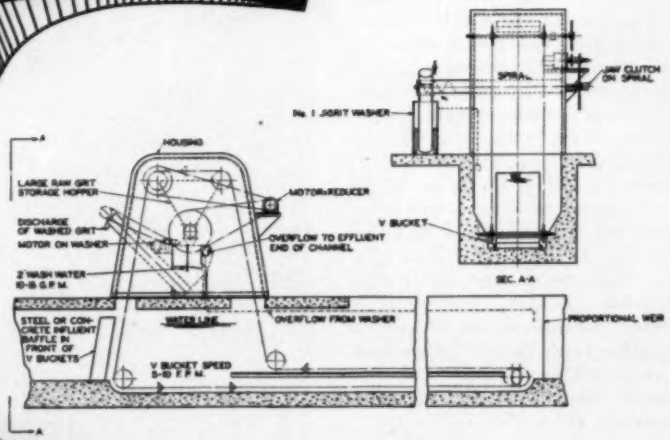
No. 709 30-inch 50-pound valve equipped with rubber seat. Air bubble tight at 80 psig and drip tight with water at 100 psig. Fully enclosed gear reduction drive. Every R-S Valve is available in smaller and larger sizes, in all materials and for lower and higher pressures.

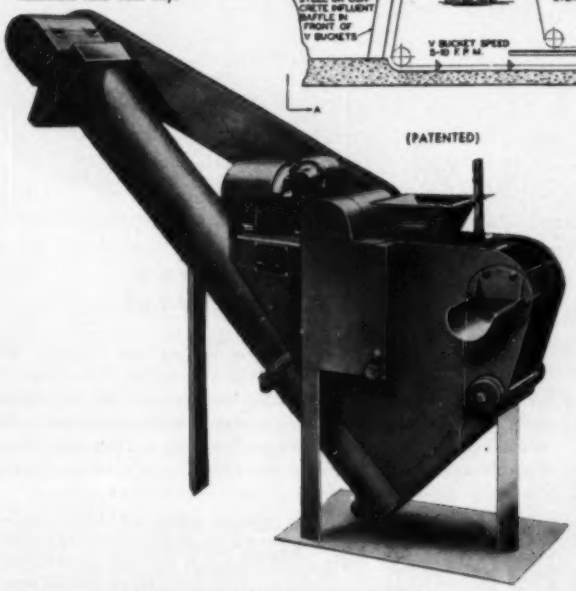
New!

Catalog No. 18 featuring R-S 50-pound valves is just off the press. Ask for it!

85% REMOVAL OF ORGANICS with "JIGRIT" WASHERS

Satisfactory and efficient grit washing is possible in any size community by using the Jeffrey system (see drawing) of grit collection and washing. Our field studies show that for best results the grit should be collected by one mechanism and washed in a separate unit. Automatic control makes it possible to operate each device a minimum time each day.





(PATENTED)

Left — Jeffrey "JIGRIT" No. 1 — a basket type jig for classifying and removing putrescible solids from sewage grit in plants of moderate size. Capacity — 20 cubic feet per hour. 90% recovery of inorganic grit. Produces a washed grit that can be used for fill or dumped anywhere without nuisance. Also No. 4 "JIGRIT" washer for washing grit at rate of 120 cubic feet per hour, and No. 9 for 280 cubic feet per hour . . in single units fully automatic in operation.

Bar Screens • Sludge Collectors • Sludge Elevators • Grit Collectors • Screenings Grinders
Garbage Grinders • Conveyors, Chains and Bearings • also equipment for biofiltration plants

JEFFREY

ESTABLISHED 1877

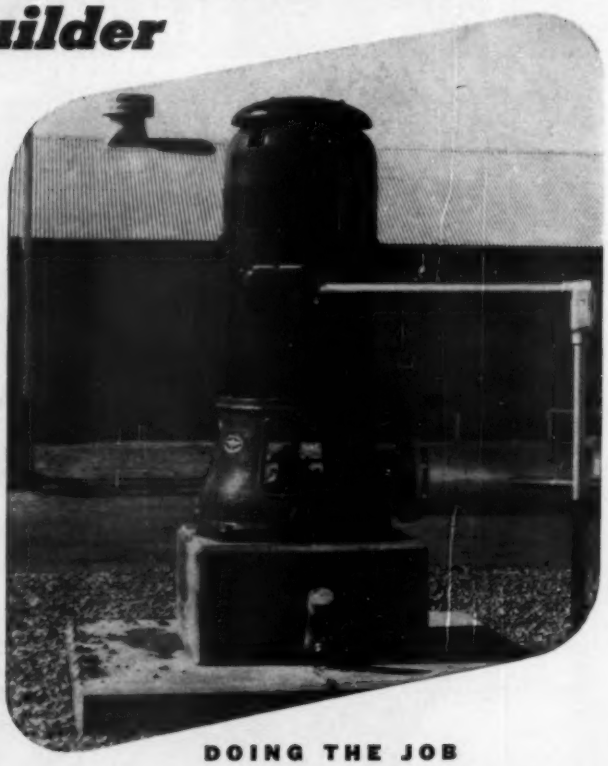
JM

THE JEFFREY MANUFACTURING COMPANY, 996 North Fourth Street, Columbus 16, Ohio

What About the Reputation of the Builder

A good reputation is more precious than great skill and fine quality. Strangely enough, a good reputation cannot be bought, nor is it ever offered for sale. It can only serve as a bond of human confidence so vital in modern business transactions. For seventy years Layne has been building a good reputation. The task isn't complete yet, nor will it ever be. But the job is far enough advanced to be bringing in many fine orders for Layne equipment and services. As a basic policy, it has aided Layne to become a great world-wide organization.

When you buy a Layne Well Water System or a Layne Vertical Turbine Pump, you are getting the assurance that if Layne equipment does not make good—the Layne Organization will!



VERTICAL TURBINE PUMPS . . .

are built in a range of sizes from 40 to 16,000 gallons per minute. Write and outline your pumping problems, or request a Layne Vertical Turbine Pump Catalog.

DOING THE JOB —COMPLETE!

Layne's planning supplements that of your own engineers, but Layne's work is complete from the test well to the finished, and in operation units—proven in production volume and fully adjusted for the task to be performed. Such a service is widely welcomed by the Nation's greatest—and sometimes smallest cities and industrial plants. It is an over-all service that saves time and gives universal satisfaction.

For further information, literature, etc.,

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BUILDERS OF HIGH EFFICIENCY

WELL WATER SYSTEMS

ASSOCIATED COMPANIES—Layne-Arkansas Co., Stuttgart, Ark. ★ Layne-Atlantic Co., Norfolk, Va. ★ Layne-Central Co., Memphis, Tenn. ★ Layne-Northern Co., Mishawaka, Ind. ★ Layne-Louisiana Co., Lake Charles, La. ★ Louisiana Well Co., Monroe, La. ★ Layne-New York Co., New York City ★ Layne-Northwest Co., Milwaukee, Wis. ★ Layne-Ohio Co., Columbus, Ohio ★ Layne-Pacific, Inc., Seattle, Wash. ★ The Layne-Texas Co. Ltd., Houston, Tex. ★ Layne-Western Co., Kansas City, Mo. ★ Layne Minnesota Co., Minneapolis, Minn. ★ International Water Corp., Pittsburgh, Pa. ★ International Water Supply, Ltd., London, Ont. ★ Layne-Hispano Americana, S.A., Mexico, D. F. ★ General Filter Company, Ames, Iowa.

Here is why
THE FAMOUS

RENSSELAER

DOUBLE-DISC GATE VALVES

open easier... seal tighter!

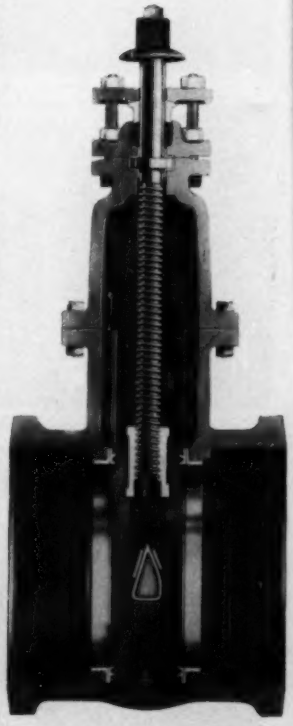
IN OPENING, THE THICK (A) SIDE OF THE STEM NUT LIFTS THE GATE ON ONE SIDE FIRST, MECHANICALLY BREAKING SEAL

GATE ON SHORT SIDE (B) OF WEDGE IS PULLED FIRST, LOOSENS EASILY. IN CLOSING, LONG SIDE (C) OF WEDGE CAUSES POWERFUL SEATING FORCE ON THAT SIDE.

THE principles of the long Wedge for greater seating power and the short Wedge for easier unseating apply to RenSSelaer Valves in sizes 10" and larger. But in ALL sizes of these famous Valves, ONE gate is ALWAYS lifted FIRST, mechanically releasing the wedges, so opening is positive. Wedging action does not seat gates until they are in *"fully closed"* position, so sliding frictional wear is minimized.

But ease of operation is only one feature of RenSSelaer Valves. SOLID BRONZE is used liberally throughout—in stems, stem nuts, wedges, seat and gate rings, glands and stuffing box nuts. Castings are high tensile strength corrosion-resistant iron. INTERCHANGEABILITY of parts insures low maintenance cost. Thousands in perfect service for over 65 years.

Experienced Field Representatives are at your call to bring you the benefit of RenSSelaer experience in Valves AND Hydrants. Their service puts you under no obligation. Call our nearest office.



Above cross-section shows 2-sided wedge on valves 10" and larger

LEADERSHIP FOR OVER 65 YEARS

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VALVES & HYDRANTS IN STOCK
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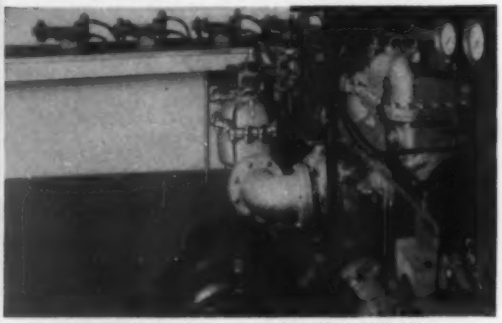
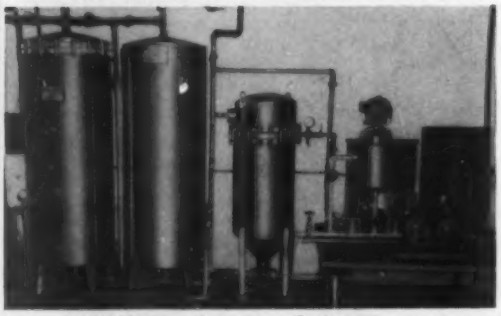
Division of Neptune Meter Company

Fluoride treatment for prevention of tooth decay



Hypochlorinating flows ranging from 60 to 3600 GPM



Typical beverage plant water purification equipment

Diatomaceous filters for swim pool

If it's Filtering or Chemical Feeding

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about . . .

- **CHLORINATION**
- **CHLORINE DIOXIDE TREATMENT**
- **CORROSION CONTROL**
- **COAGULATION**
- **FLUORIDATION**
- **SEWAGE TREATMENT**
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In communities of all sizes, from small town to giant city, %Proportioneers% has solved the problems of water purification and filtering. With experience gained from over 27,000 installations, %Proportioneers% knows the answers and can save you money. It pays to bring your water treating problems to us! Bulletins on request.

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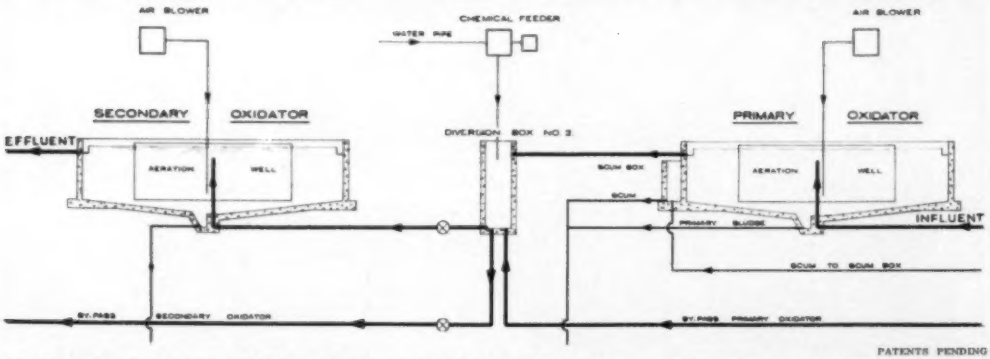
Requirement:

Flexibility of operation in clarification unit.

Specification:

THE PROCESS OXIDATOR



PATENTS PENDING

Clarification flow diagram for Bio-oxidation plant at Hemet, Calif. Engineers: Ralph S. Brooks and James G. Carwile. Contractor: Herman A. Teget

Proven Points of The Process Oxidator

- Improved clarification
- Higher removal of suspended matter
- Increased grease removal
- Minimum scum handling
- Greater reduction in bio-chemical oxygen demand
- Elimination of odors by maintaining sewage in fresh condition
- Lower capital cost and upkeep

Write to either address below and one of our specialized Engineers will be glad to assist you with your particular problem.

Installation after installation proves that the Process Oxidator answers every demand of a clarification unit whether large or small. In Hemet, California, the new sewage plant for 5,000 people, had special need for a treatment process that would have flexibility suitable for intermediate or complete treatment at low cost. As the flow diagram shows, Process Oxidators were specified and arranged for parallel or series operation to be used with or without chemicals. This installation assures perfect control and economy of operation for normal flows to peak loads.

Whether it's a $50,000 or a $5,000,000 bond issue, specification of the Process Oxidator will mean lower initial cost, higher efficiency in operation and reduced maintenance cost.

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Complete Service for Elevated Water Tanks—
Nation Wide Service—30 Years Experience

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YOUR TANK THE DIXIE WAY

By welding seams, pits and rivets which gives a riveted tank 15% more Safety Factor than it had when built. No rivets removed, water supply maintained while work is in progress. On completely reconditioned jobs, the painting is guaranteed for five years, repairs guaranteed for ten years, provided the tank is painted every five years. Yearly inspection, making all adjustments, if any, without additional cost.

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SOUND PRINCIPLES OF WATER TANK MAINTENANCE and TANK TALK, by W. A. RILEY

—SAFETY—SERVICE—SATISFACTION—

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THE LARGEST ORGANIZATION OF ITS KIND GIVING SAFE MAINTENANCE AT LOW COST

MACHINE A-C PIPE TENONS ON-THE-JOB IN 5 MINUTES

This new low-cost SPRING LOAD Asbestos-Cement tenoning machine is the most dependable, accurate and efficient asbestos cement (or wood) pipe tenoning machine made. It is designed SPECIFICALLY for on-the-job tenoning . . . to cut as accurately as a lathe to close tolerances . . . to stand up under rough use. Two models: No. ACT-8 for 4" to 8" pipe; No. ACT-20 for 10" to 20" pipe.

TESTED AND APPROVED by one of the country's leading pipe manufacturers

A companion tool to famous SPRING LOAD A-C PIPE CUTTERS

SPRING LOAD A-C TENON MACHINE *Cuts Costs!*

- ★ ELIMINATES EXPENSIVE LOADING, HAULING, AND LATHE OPERATIONS
- ★ PORTABLE, ONE-MAN, ON-THE-JOB TOOL
- ★ LONG-LIFE CARBALOY CUTTING TIP
- ★ MACHINES UP TO 6" TENON IN A-C OR WOOD PIPE
- ★ NO CHATTER—CUTS SMOOTH AND ACCURATELY AS A LATHE
- ★ BUILT TO LAST

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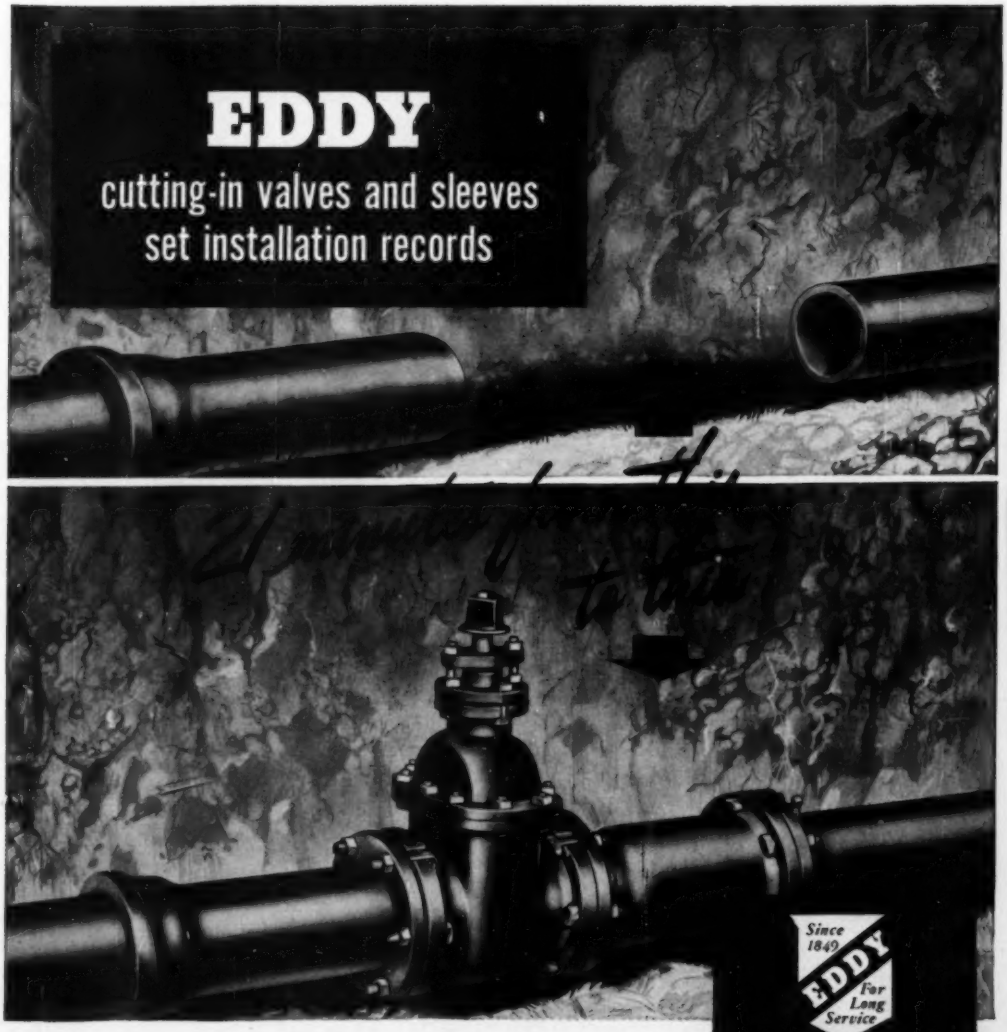


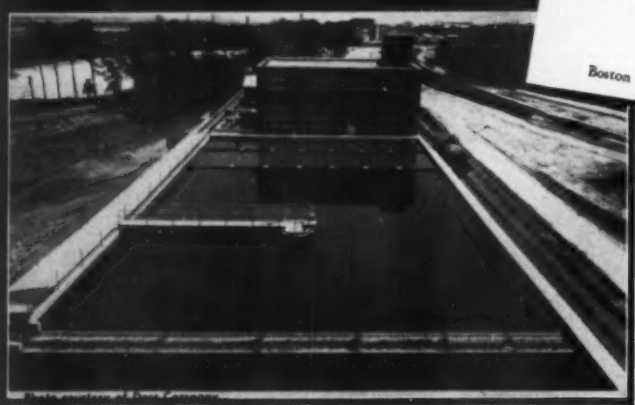
★ The National Board of Fire Underwriters recommend spacing valves every 500 to 800 feet on underground water distribution lines. Eddy cutting-in valves and sleeves with their mechanical joints save time . . . make the job easy and simple to perform on existing pipe lines. No caulking experts and no lead-melting equipment are needed. ★ After excavation and following removal of a section from the water main or hydrant stub, two men and a ratchet wrench can complete the job in twenty-one minutes—with all joints "bottle tight" under pressure. Work can be done in any kind of weather . . . in a flooded trench . . . fast and sure should emergency require. ★ Stock up now with Eddy cutting-in valves and sleeves and be ready for speedy, on the spot installations as circumstances may permit. Valves meet AWWA specifications . . . are available in sizes 3 to 12 inches . . . for use on both sand cast and centrifugally cast iron water pipe.

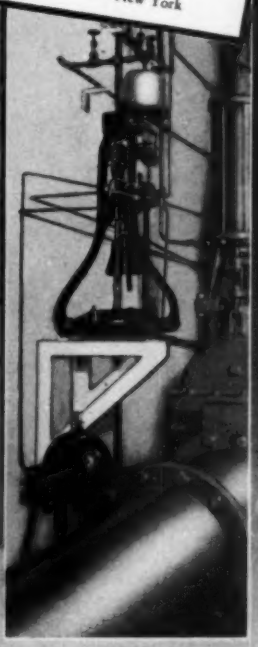
HOLLINGSWORTH & WHITNEY CO.

Water Treatment Plant, Mobile, Ala.

(Completed in 1949)

FAY, SPOFFORD & THORNDIKE
Engineers
Boston New York





An important requirement in the manufacture of high quality paper is an ample supply of clear, colorless water. At the Mobile, Ala., plant of Hollingsworth & Whitney Co., well-known paper manufacturers, process water virtually free of color and turbidity is supplied by a modern 10 MGD filtration plant employing the latest equipment and treatment methods.

Builders Meters, Controllers and Filter Equipment, installed by Rust Engineering Co. of Pittsburgh, Pa., contribute to the excellent performance of this notable industrial plant. For Bulletins describing Builders water works equipment address Builders-Providence, Inc., (Division of Builders Iron Foundry), Providence 1, R. I.

Builders-Providence equipment furnished for the Hollingsworth & Whitney Co. filtration plant:

- **14" Model RCB Hydraulically-operated Filter Effluent Rate Controllers**
- **Model GA52-IR Loss of Head and Rate of Flow Indicating-Recording Gauges with Diaphragm Pendulum Actuators**
- **14" Model RCB Rate Controller with Chronoflo Transmitter and 24" Double Dial Illuminated Indicator for Wash Water**
- **36" Model VT54 Venturi Tube, Chronoflo Transmitter and Chronoflo Totalizer-Indicator-Recorder, for Raw Water**
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BUILDERS-PROVIDENCE
Instruments

specify

GENERAL CHEMICAL "ALUM"

WATER experts agree—"alum" is the preferred coagulant for the removal of turbidity, color and other impurities in the water . . . *and General Chemical Aluminum Sulfate is the preferred "alum."*

SEWAGE experts agree—"alum" is preferred for the clarification of sewage because it flocs out the suspended solids and colloids . . . *and General Chemical Aluminum Sulfate is the preferred "alum."*

THE REASON: For over 50 years, General Chemical Aluminum Sulfate has been processed to meet the most rigid chemical and physical specifications. Its quality, uniformity and reliability are preferred by most cities the nation over. For your operations, *specify General Chemical "Alum."*

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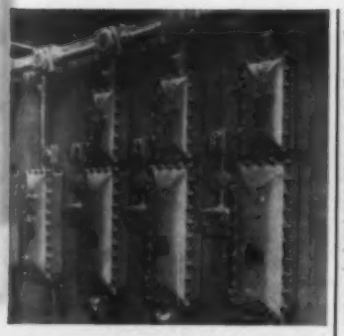
G-E CO-ORDINATED EQUIPMENT PAYS OFF AT JAMAICA PLANT

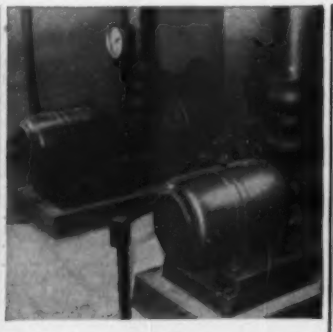
For seven years, this modern General Electric equipped sewage-treatment plant near Jamaica, N. Y., has been serving a large section of the Borough of Queens, New York City. The plant now has a capacity of 65 million gallons, but ultimately it will treat 100 million gallons daily as a major part of the city's $200,000,000 pollution-control program.

G-E engineers, familiar with the problems of sewage disposal, co-operated with New York City engineers in co-ordinating and installing electric equipment at Jamaica. Because of this, G-E equipment has, since its installation, been giving efficient and economical service in every stage of treatment—from screening and pumping to sludge digestion and power generation.

Whether you plan a big or small installation, you'll profit by contacting your G-E representative early. Let him help you plan your electrical layout. You'll find the nearest G-E office listed in your 'phone directory. *Apparatus Dept., General Electric Co., Schenectady 5, N. Y.*



In the Sludge Pumping Chamber, where explosive gases are a constant hazard to equipment, these explosion-proof controllers insure positive operation of sludge-pump motors.



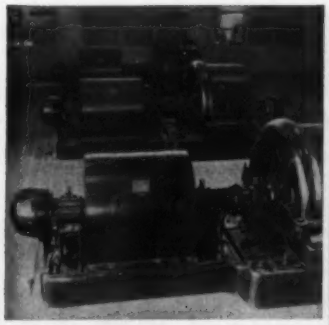
These G-E totally enclosed, fan-cooled, 15-hp motors are coupled to hot-water-circulating centrifugal pumps for heating buildings, and sludge in sludge-digestion tanks.

At the "front lines" of the process, G-E submersible, 2-hp motors drive bar screens. Subjected to constant dripping and occasional submersion, these motors have given high-continuity service for seven years.

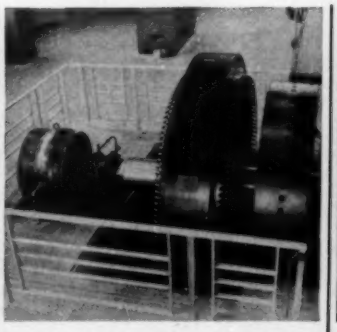
GENERAL ELECTRIC

Airview of New York City's Jamaica Sewage Plant. Equipment used here for sewage treatment includes mechanical screens, grit chambers, fine screens, pumps, aeration tanks, settling tanks, chlorination apparatus, excess-sludge thickening tanks, sludge-digestion tanks and power-generation equipment.

Fairchild Aerial Surveys, Inc.



In the operating room of the Blower and Power Building, these G-E 700-hp, 3-phase, variable-speed motors drive centrifugal blowers for aeration in the activated sludge treatment.



Shown here is one of three G-E 1250-kva, 3-phase, synchronous generators used to supply blower motors and auxiliary equipments. Gas from sludge-digestion tanks feeds gas-engines which drive generators.

G-E drawout metal-clad switchgear is used in control of incoming feeders, pumps, capacitors, transformers and generators. Here is an installation in the Pump and Screening Building.

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by better meter repairs...

here's how you do it

This Manual, sent gratis to Water Works operators, contains a wealth of factual data on modern meter shop practice in planning efficient shops, and testing and repairing water meters. A copy will gladly be sent to you upon request. Get this Manual, study its shop-plans, its work sheets, its record cards, its photos . . . and learn how to increase your water revenue.

Practice proves that properly tested and repaired water meters substantially decrease unaccounted-for water — with consequent increase in revenue. The under-registration of meters, especially on low flows, is the real "revenue thief"; and repairing meters to catch the small flows pays impressive dividends. How this can be true, is readily seen, when you consider that 25% of all water flows through domestic meters at 1 gpm or less — and between 11 and 16% at under ½ gpm. Here then, is your way to balance increased production costs with sales . . . consult your Trident Representative for further helpful advice on a testing and repair program.

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WATER & SEWAGE WORKS

Vol. 97, No. 2 FEBRUARY, 1950

A Gillette Publication

SEWAGE AND INDUSTRIAL WASTES —1949 IN REVIEW—

by

ARTHUR H. NILES

Engineer-Superintendent

DIV. OF SEWAGE DISPOSAL

TOLEDO, OHIO

(President, Sewage Works Federation)

ANNUAL reviews might be compared with ladies' dresses. Some are long, sleek, streamlined formals and others are frilly, snappy, abbreviated and very interesting ballet models. The "New Look" applies to any model between the formal and the ballet style. *This* review might be cataloged as a two piece "New Look" model.

In the past, some of the reviews appearing in this magazine have dealt principally with domestic sewage, with all of its ramifications, while Industrial Waste Treatment has been dealt with as the "ruffles and trimmings." As the 1949 meeting of the Federation of Sewage Works Assns. in Boston so clearly illustrated, industrial waste treatment has now "come of age" and is receiving an increasing share of interest by those responsible for sewage treatment and sewage works design.

The first part of this review deals, logically, with the principal or outstanding developments in domestic sewage treatment, but when the matter is carefully considered, it is impossible on a practical basis to separate the treatment of sewage and the treatment of industrial waste and still have a complete "creation." Studies in research, for example, must almost always deal ultimately with combinations of domestic and industrial sewages.

SEDIMENTATION & DIGESTION

In the field of sedimentation there has been little new unless the plant at Daytona Beach, Fla. is so considered. There lime sludge from the water softening plant is used to aid settling in the primary sedimentation tank of the sewage treatment works. Pilot plant studies indicated a 70 to 80 per cent over-all B.O.D. removal with only one hour detention, but as yet no operating data have been forthcoming.

The Author

Digestion Tanks

External sludge heating and recirculating of digesting sludge continues to hold major interest. As digesters, which were designed with interior coils for hot water heating, become older and failures of the heating coils become more and more common, designers and operators alike turn to some device that can be easily maintained, require little attention and still automatically hold the digestion temperature desired.

Digestion in the thermophilic range (113°-145° F.) has long been considered desirable from several standpoints by many authorities. If a plant has a sufficient amount of gas there is no reason why any operator should hesitate to experiment with thermophilic digestion under his own conditions if his digester is equipped with an external sludge heater. Because this method of digester heating is not as economical from the B.T.U. standpoint as with coils, it is necessary to have ample capacity in the external sludge heater and there should be plenty of gas available for thermophilic digestion experiments.

In many plants, scum is a very troublesome matter in digesters. Where the sludge is in constant or almost constant circulation through an external sludge heater, scum no longer is the headache it used to be. Automatic controls on these heaters have been developed to the point where almost any combination of manual and automatic operation is now obtainable to fit the local conditions.

Unheated digesters are now generally used only as sludge storage in connection with heated tanks. Lagooning of raw sludge is still practiced in some sections of the country but many authorities agree that this should be avoided wherever possible.

Sludge Utilization

Digested sludge continues to be prepared and sold for fertilizer in about the same number of places where it was started. Some of the

In 1949 Use of Mechanical Labor Saving Equipment Was Decidedly on Increase.
Los Angeles digs sewer trenches straight, true and to exact depth with a Bucyrus-Erie "Hydrocrane". On right, note smooth walled trench containing "Ceramicweld" pipe jointed with new flexible couplings for clay pipe.

critics have indicated it was a case of having a "bear by the tail." However, those plants, such as the Southwest Plant of the Chicago Sanitary District, where they are equipped to either incinerate the sludge or produce fertilizer depending on which is more economically feasible, are still making fertilizer. This would tend to refute the claims of such critics. The application of liquid sludge to farms and gardens as practiced by Backmeyer of Marion, Ind. and formerly by Damoose of Battle Creek, Mich. does have the advantage of retaining all those fertilizing elements lost in the sludge filtrate. There has been no great rush to follow their lead, probably due to the trouble and expense involved together with relatively meager financial returns. Where farms may be served directly by digested sludge pipe lines such as at Canton, Ohio's old treatment plant, liquid sludge farming offers a somewhat greater possibility. This would seem to hold greater promise in southern California where fertilizing and irrigation could be accomplished at the same time.

SECONDARY TREATMENT

Standard and High Rate Filtration

Some 15 to 20 years ago it was common practice to design trickling filters 10 ft. deep and use such a rule of thumb as 2500 population equivalent per acre ft. Researchers soon determined that the top 2 to 3 ft. of a filter was the most effective portion. From these studies, high rate filters with or without recirculation, bio-filtration, roughing filters followed by standard rate filters, etc., have all been tried with varying degrees of success. One of the latest reviews of efficiencies of shallow (3 ft. depth) recirculating filters was made by Moore, Smith & Ruchhoft[1] at the Elizabethtown, Ky. sewage plant which handled domestic and industrial wastes which included slaughter house, laundry and milk plant wastes.

The conclusions reached were that there was no break in the straight line relationship between B.O.D. loadings and removals and that best overall filter efficiency and plant performance

New Flexible Sewer Joint
(Development of Pacific Clay Products Co. for plain end terra-cotta pipe.)

was obtained with the filters operating in series. This gave an average over all B.O.D. removal of 88 per cent and a final plant effluent of 24 ppm. from a raw sewage of 300 ppm. B.O.D. and 240 ppm. suspended solids. This is a good illustration of how far filter design has progressed in the last 20 years.

Activated Sludge

Designers and operators of activated sludge plants have been constantly striving for lower initial cost of plants and either greater efficiency, or to give the same results at less operating cost. One direction in which the initial cost may be reduced seems to be a shorter aeration period—therefore, a smaller tank. This may be accomplished by greater efficiency in the use of air and such economies as step aeration or tapered aeration are considered standard practice. Other devices, such as finer dispersion of air bubbles, have been subject to much study by manufacturers. This has resulted in many claims for greater efficiency by such devices as "Wide Band Aeration," Swing Diffusers, Jet Aeration, Diffusair and others. So many claims and counter claims have resulted in confusion and the Sewage Works Practice Committee of the Federation of Sewage Works Assns. decided that a "Manual of Practice on Air Diffusion in Sewage Works" was badly needed. These studies have been completed and the manual has been written, revised, and is now in the final editing stage prior to anticipated publication about the middle of 1950.

Another approach to secure greater economy and efficiency is through greater concentration of solids. The attempt to carry 5000 to 10,000 ppm. of solids in the aeration tanks instead of say 2000, was found some years ago to be desirable but the accomplishment was another thing. One process was to add to the mixed liquor some inert solids such as silt, clay, ash or asbestos in order to cut down on the amount of volatile material and yet keep a high concentration of solids. More recently there has been the thought of adding oxygen or ozone to the diffused air with the idea of keeping the volatile sludge in a more operable condition. Okun, when at Harvard, did considerable work in

an experimental way with the oxygen process, and more should be heard from it. Currently, the National Ozone Co. of Cleveland, Ohio, is installing ozone equipment at the Celina, Ohio activated sludge plant, together with all necessary metering devices, so that an economic study of ozonation can be made. No doubt, this development will be carefully watched. Cost of oxygen or of ozone has been the key to the whole question. Dr. Mohlman suggests that oxygen would have to be supplied at about $5 per ton in order to be economically feasible but he thinks this may be possible. If ozone can be made cheaply, it may be even more attractive. The present plant scale operations at Celina may be very significant.

NEW METHODS AND IDEAS

Polarographic determination of dissolved oxygen as described by Moore, Morris & Okun[7] is not exactly new but bids fair to be developed to the point where commercial installations will be on a par with recording pH equipment. It is not hard to visualize the possibilities of this type of equipment in connection with an activated sludge plant. Much time, trouble and expense could be saved by knowing the variations in dissolved oxygen content in the aeration tank, as shown on a recording and indicating instrument. This may not be available as yet from equipment manufacturers but if there is sufficient demand, it undoubtedly will be further developed and produced.

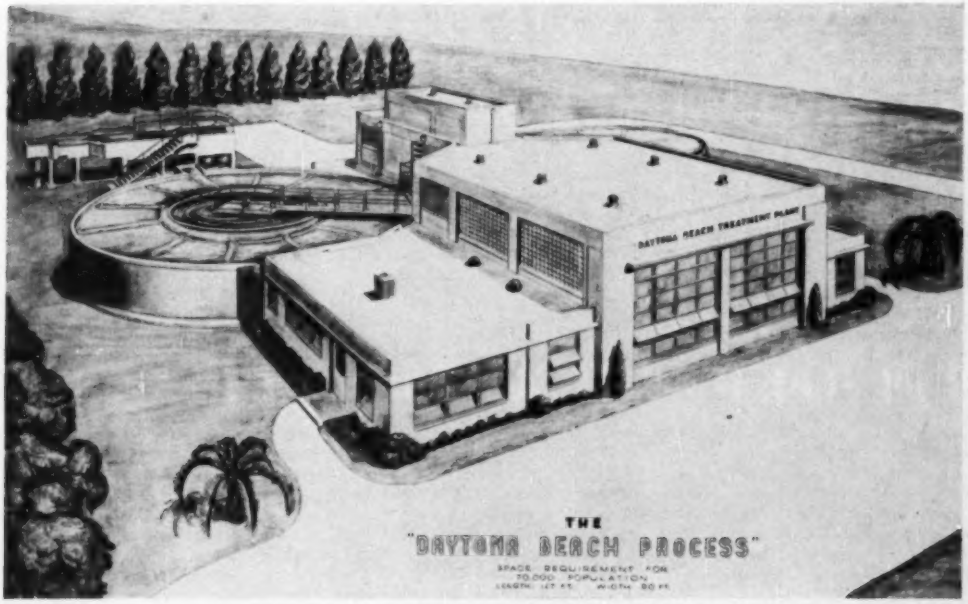
Sewers of "Transite" Pipe Increasingly Used
(This one a 10" sewer at Bremmerton, Wash. MacClenny, Fla., completed an entire new system with "Transite" pipe throughout.)

Another useful piece of equipment is the photolometer used in the photoelectric estimation of suspended solids in sewage, as described by Setter, Price, Grossman and De Grazia[8]. As a means of activated return sludge control, for example, the method seems to offer considerable promise as an aid to the efficient operation of activated sludge plants.

The photolometer itself is in production by scientific equipment manufacturers but with a little more demand for equipment of this nature it could be produced with automatic controls within a comparatively short time.

Another relatively new and rapid method of determining oxygen requirements in activated sludge plants was described by Dawson and Jenkins[9] and the application of differential manometers to the measurement of B.O.D. of sewage was described by Caldwell & Langelier[10]. These instruments have been used quite extensively to measure uptake of oxygen and Warburg has recently come out with a new improved circular model. One of the great drawbacks of the standard 5 day B.O.D. determination is the long lag in time. For operational control, a much quicker even if somewhat less accurate method, is badly needed. It appears that this may be a possible answer.

With these potential new control instruments, it looks as if activated sludge plants could be made almost



Daytona Beach, Fla., Placed Novel Compact Plant in Service

The "Daytona Beach Process" consists of a form of economical up-flow chemical precipitation, employing sludge from local water softening plant and mild aeration—1/10 c.f. per gal. A second plant is being proposed for Sarasota, Fla., the proprietors guaranteeing 65 to 85% B.O.D. removal, depending upon quantity of air used—½ c.f. per gal. for 80 to 85% removal.

P.F.T. Develops Large Capacity Rotary Distributor for New Stockton, Calif., Plant

(With arms of genuine Wrought Iron pipe 14" to 10" size for 166 ft. diam. filter and the newly developed snap-off-and-on type of orifices and jet spreaders pictured in inset. This unit handles 12 M.G.D. of mixed filter effluent with settled combined canning plant wastes and domestic sewage. Plant, built especially to handle canning wastes, was designed in office of C. C. Kennedy, San Francisco.)

automatic. It would seem that this is a place where instrument manufacturers have not kept pace with needs. If such indicating and recording instruments were available, the cost even though high, could be saved in a very short time through increased efficiency, savings of air for diffusion and almost completely eliminating the possibility of plant upset due to some shock load.

It is not assumed, however, that the demand for competent operators will be lessened because even if instruments were made automatic in operation, such equipment has a habit of needing attention and servicing by highly skilled technicians.

Pure Culture Sewage Treatment

Half in jest, half in earnest, a new idea was put forth by F. P. Fischer[6] for future sewage treatment, called Bio-Phage Nutrient Process. Mr. Fisher proposes the addition at selected points in the system of nutrient hormonic infusions together with carefully cultured, robust, specific pure culture organisms. Whether this idea ever will be a practical process will not be known until a lot of research has been done but some such apparently "screwball" ideas have paid off in the past, and so may this one.

Flexible Sewer Pipe Joints

Engineers have long sought a sewer jointing material which would be watertight, flexible enough to deflect somewhat without leaking, prevent roots from entering and which could be made under water. It is claimed such a joint is now being made by the Pacific Clay Products Co. of Los Angeles, Calif., under the name of "Ceramicweld." Made of rubber, it will resist acid, alkali, greases and solvents in sewage and temperatures in excess of those normally found in sanitary sewers or industrial waste lines. The clay pipe is made with both ends "spigots," which are inserted in the coupling or joint. Steel bands are tightened about the gasket, which is then filled with cement grout. No cost data are available but, the joint appears to have possibilities.

OHIO RIVER COMPACT COMMISSION

June 30, 1948, has rightly been rightly called the most significant date in recent sanitation history. On this date the Ohio Compact Commission was given the mandate by the eight signatory states to regain the treasure of clean waters for the millions of people and thousands of industries located in the valley of the Ohio River. The magnitude of this work and that of the National Water Pollution Control Program as resulting from the signing on this same date by the President of Public Law No. 845, certainly makes June 30, 1948, as one long to be remembered in sanitation annals.

The first annual report of the Ohio River Valley Water Sanitation Commission covering the fiscal year ending June 30, 1949, was issued Nov. 15, 1949, by J. L. Quinn, Chairman, and Edward J. Cleary, Exec. Dir. and Chief Engr. The report begins with this statement:

"Whoever may be concerned with the abatement of stream pollution will find guidance for his efforts in these words:

'A river is more than an amenity, it is a treasure. It offers a necessity of life that must be rationed among those who have power over it.'

This profound statement forms part of an opinion of the U. S. Supreme Court, which was handed down in 1931 by Mr. Justice Oliver Wendell Holmes in a decision involving diversion of Delaware River water."

Among the accomplishments of the commission are the following:

1. Established standards for the 22 mile stretch of the Ohio known as the Cincinnati Pool. On this information Cincinnati as well as northern Kentucky cities discharging into the pool are now proceeding with the design of sewage treatment work.

2. Made findings-of-fact in the Pittsburgh as well as the Huntington areas on water quality requirements in order to expedite the construction of remedial works.

3. Took action in conjunction with two states to prevent the discharge of new pollution in the form of hardness-producing wastes from industrial plants.

4. Secured factual evidence of pollution loads in the Wabash River.

5. Undertook a cooperative program with the Armco Steel Corp., the Wallace & Tiernan Co. and the State of Ohio looking toward development of a method to treat phenol wastes.

6. Established a special unit with the help of federal funds to aid in the development and acceleration of industrial waste control measures.

7. The commission has also participated in discussions favoring modification of federal tax laws to permit accelerated depreciation of capital expenditures for industrial waste treatment plants, and consulted with federal officials on the establishment of synthetic fuel plants and means to meet the problems of adequate water supply and discharge of waste substances.

PUBLIC LAW No. 845

The Water Pollution Control Division of the United States Public Health Service was established to activate Public Law No. 845 signed on that historically significant date, June 30, 1948. In order to assist the Public Health Service to carry out the provisions of the law a Water Pollution

Control Advisory Board was established. Composed of 11 members, six are non-federal individuals appointed by the President and which represent wild life, conservation, industry, engineering, municipal government and scientific research. The five other members including the chairman, Mark D. Hollis, (who is Chief Sanitary Engineer of the Public Health Service) represent the Departments of the Army, Interior, Agriculture and General Services Administration. One of the first acts was to partition the entire country into fourteen (later reduced to ten because funds for the fiscal year 1950 were insufficient) major river basins for administrative purposes.

An appropriation of $2,200,000 was made available to the U.S. Public Health Service for 1950, $1,200,000 of which was for operation and administration (including research) and $1,000,000 was for grants to state and interstate agencies, and to the Territories for the study of water pollution caused by industrial wastes. Actually $782,979 has been granted to 45 states, 4 territories and to the District of Columbia to this time.

In order to formulate a comprehensive program for water pollution control it was necessary to have each of the states compile data showing the sources and amounts of pollution of each of the river basins. Those data should be completed early in 1950 and will form the basis of the Federal plan and for supporting state water pollution programs. These comprehensive reports will be exhaustive, probing inventories of pollution conditions throughout the country today—watershed by watershed, river basin by river basin—and the factors contributing to and created by water pollution. "In the eyes of the Public Health Service a comprehensive program of water pollution control has four elements: (1) determination of existing stream conditions, including the pollution load; (2) determination of desirable stream uses; (3) the fixing of water quality requirements; and (4) the development of corrective measures based on the first three phases."

The comprehensive program will of necessity be subject to change from time to time as conditions warrant, but the adoption of corrective measures, will not await the development of the ultimate comprehensive program. The preliminary control program, facilitated by utilizing data already available, "will provide (1) a reference point from which to measure the progress of pollution abatement; (2) a guide for acquiring necessary additional data; (3) a basis for the logical development of additional comprehensive programs; (4) a basis for loan approvals, when funds are appropriated for this purpose, and (5) an educational document to be used in supplying information to the public and to officials concerned with the direction of water control pollution activities."

The previously mentioned Water Pollution Control Advisory Board had two meetings in 1949. At the second meeting of the Board it recommended to Surgeon General Leonard A. Scheele, that "a firm policy be pursued to insure abatement of pollution of, interstate waters." Preparation of the "essentials" of a uniform state law which could be adopted in part or in whole by states interested in strengthening their water pollution control activities, was also recommended. The Board endorsed continuation of special grants for study and research problems having sectional or National significance and suggested that preference be given to projects in which industry cooperates by supplying funds or skills. This action reflects the Board's belief that the solution of industrial waste problems in the Nation's waters is primarily the responsibility of industry.

The Board concluded its policy-making recommendations by adopting a motion that the Public Health Service encourage formulation of uniform methods of waste analysis among the various professional technical organizations engaged in water, sewage and industrial waste activities.

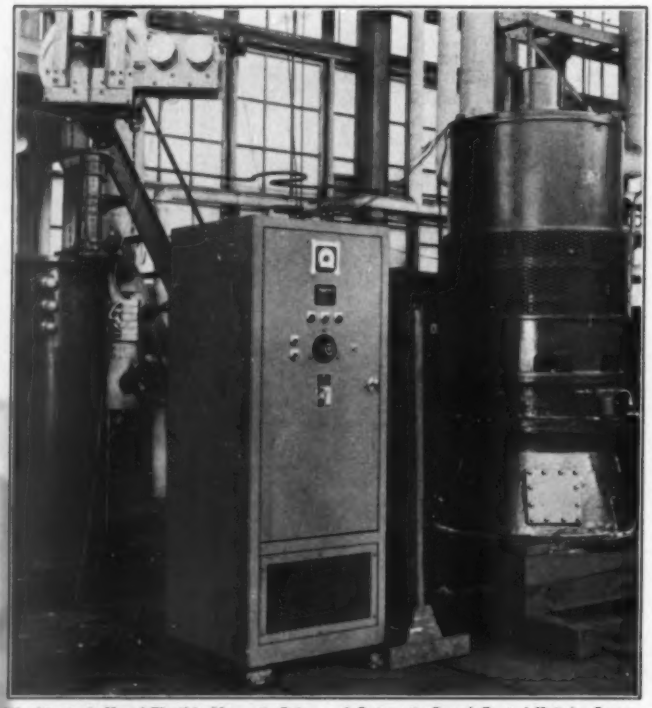
POPULAR INTEREST IN POLLUTION ABATEMENT

No program in pollution abatement control can be truly effective without adequate public support. The progress made thus far would not have been possible except for the arousing of public opinion by conservation groups, wild life sanctuary groups, Isaac Walton Leagues, Sportsmen's Congress, sewage plant operators who speak before local organizations and anyone who has the knowledge and ability to carry on the gospel of "Clean Waters." Such recent popular articles as "Foul But You Drink It" by H. H. Smith, in Sept. 1947 and "Florida-Polluted Paradise" by Philip Wylie, in April 1949, have given additional popular impetus to the whole program of water pollution abatement. In the case of Florida, David B. Lee, Director of the Bureau of Sanitary Engineering, gives the following summary of the 1949 program in municipal waste treatment: Plants have been completed at Daytona Beach, Winter Garden, and Winter Park; construction is under way at Ft. Lauderdale, Jacksonville Beach, MacClenny, Ocala, Orlando, Tampa, and Winter Haven; plans are being drawn for Lake City, Miami, and Vero Beach.

Completion of the 6 mgd. high rate filter plant to serve Orlando, a city of over 50,000 permanent residents, is expected by March, 1950. The installation of this treatment plant will terminate one of the most serious pollution problems in Florida as the city of Orlando formerly placed all of its waste into drainage wells.

P.F.T. Sludge Heaters and Heat Exchange Units Installed at Dayton, Ohio

(This battery of four units, rated at 500,000 B.t.u. per hour, heat mixtures of raw solids and recirculated digester contents. Each unit has its individual recirculating sludge pump and automatic temperature controls. The adoption of external sludge heaters and sludge recirculation has been proceeding at a rapid rate in connection with existing as well as new plants.)



Worthington's Novel Flexible Magnetic Drive and Automatic Speed Control Unit for Sewage Pumps

(The first units to be installed are those pictured here for Boston's new Nut Island Plant. Philadelphia has also selected this new vari-speed pumping control and equalizing assembly for its new treatment plant.)

Florida Industrial Waste Progress

The Florida State Board of Health is conducting an extensive survey over a three-year period of the phosphate waste problem sponsored by the phosphate industry. This is expected to settle the controversial questions regarding the amount of wastes discharged, its effect on the receiving streams and other related matters. Similarly a brief study is being made of the pulp and paper mill industry waste under joint sponsorship of industry, the Florida State Board of Health, and the National Council for Stream Improvement. Citrus waste is still a serious problem and the progress to date has consisted mainly of better housekeeping and segregation of stronger wastes with final disposal in isolated areas.

Boston Metropolitan Area

This area has long been the subject of much research and study. It will ultimately involve construction of three primary treatment plants, one at Nut Island, the second, called Calf Pasture and the third at Deer Island. The first phase of the correction of the problem consists of the design and construction of the 112 mgd. Nut Island Treatment Works for 900,000 persons. The concrete work of the plant has been completed and the mechanical equipment has been purchased and stored in warehouses. Contracts for the installation of this equipment have recently been awarded and the plant is expected to be in operation early in 1951.

New York City Treatment Progress

Ground was broken on Nov. 7 for New York City's 120 mgd. Hunts Point plant and the 26th Ward Sewage Treatment Plant has just been completed and placed in full operation although it operated as a partial treatment plant for some time previously. The dual fuel gas engines are not yet all installed as this is being written. This plant will take its place along with the six other plants of which the New York Dept. of Public Works can be justly proud, and is the latest step in the carrying out of the comprehensive plans adopted several years ago: Coney Island, Wards Island, Tallmans Island, City Island—Harts Island, Bowery Bay, Jamaica and now the 26th Ward plant have been orderly steps in the completion of the overall program ultimately involving 17 plants, 1,619 mgd. and some $275,000,000 total expenditure. The newest plant replaced an old sanitary landmark (a treatment plant constructed about 1890-96 housed in a circular brick building, and designed to treat about 3 mgd. from an area having a population of some 60,000 persons). The new plant is designed for a flow of 60 mgd. and an expected population in 1970 of 480,000. The present flow is around 50 mgd. from some 415,000 persons.

Philadelphia Program Moves

The abatement of pollution in the Delaware River basin is a very large undertaking but once decided upon has made rapid progress. The first unit of the program in the Philadelphia area is the North East Works, which should shortly be completed and placed in operation. It has a designed capacity of 125 mgd. for 876,000 persons in 1970, separate sludge digestion with heated digesters and with abbreviated activated sludge for secondary treatment to give a suspended solids and B.O.D. reduction of 75 per cent. The second unit is the South East Works designed for 136 mgd. and the third is the South West Works designed for a flow of 140 mgd.

This makes total capacity for the plants in the Philadelphia area of 400 mgd. and will entail a total cost around $60,000,000. The work is also proceeding on the latter two plants with some units under construction and others almost ready. All three plants are scheduled for completion by the end of 1953.

Some 32 municipalities below Philadelphia are joining into workable groups to best take advantage of their natural drainage area and construct works to comply with the orders of the Sanitary Water Board to abate pollution of this stretch of the Delaware River.

Baltimore Adds to Plant

At Baltimore, sewage works additions are planned to the extent of about $2,000,000 and some are actually under construction to keep this 33 year old plant up to date. The tributary population has increased 2½ times in that period. Baltimore sells some 30 to 40 mgd. of plant effluent to the Bethlehem Steel Co. for industrial purposes. This helps cut down the amount of plant effluent entering Back River, a sluggish tidewater stream. This city was one of the first to encourage the use of unprocessed sludge for fertilizer. Then for quite a period of time they seemed

to think it did not pay to process it. It has now been decided to spend a million dollars for sludge drying equipment alone since vacuum filtration was installed in 1938 and all digested sludge has been dewatered by this means and the sludge deposited on the grounds.

Pittsburgh Makes Progress

The Allegheny County Sanitary Authority, after studying the pollution abatement problem in Allegheny County on a county-wide basis involving 102 municipalities, has now modified its program to provide treatment facilities for 59 municipalities with a reduction in construction cost from $82,000,000 to $49,000,000. This effected a corresponding reduction in sewage service charge of about 16 per cent. While a considerable saving in construction cost is being made by this revision of original studies the problem of maintaining overall stream pollution control presents much greater difficulties as compared to one plant for the entire area under a single administration. Under the new plan there will be several plants instead of the one large plant of 175 mgd. average flow which was to have been located some 3½ miles below the "Point" and serve the entire county. The Central or Pittsburgh District, known as Project "Z," will have an average flow of 141 mgd., serve about 80 per cent of the entire population under order to abate pollution in Allegheny County but will be located at the same place as selected for the one large plant. Under the present plans the project involves 35 miles of tunnel construction in addition to 28 miles of intercepters other than tunnel type. The treatment plant will be designed to remove 50 per cent of the B.O.D. as required by the State Sanitary Water Board and confirmed by the Ohio River Valley Water Sanitation Commission.

Detailed plans and specifications are to be completed by the end of 1951 and are being financed by means of a $2,000,000 loan arranged through the City of Pittsburgh. This will be expended exclusively for engineering and administration expense over the next two to three years. This loan will be repaid through revenue bonds which will be issued when construction work is commenced.

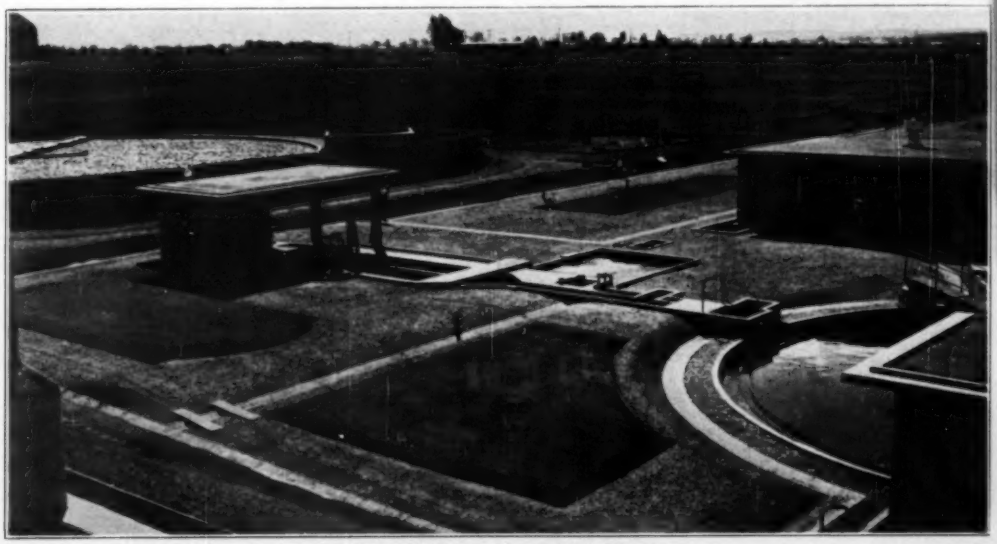
Cincinnati Gets Under Way

Cincinnati, always among those in the forefront concerning matters of civic development, anticipated the Ohio River Compact by starting work on its intercepting sewer system, establishing the sites for its sewage treatment plants and enacting the service charge ordinance to provide funds for construction of the works as well as for operation, all prior to the signing of the compact on June 30, 1948.

In fact designs were made for the Little Miami Treatment Works in 1939. These subsequently were restudied by the engineers and were revamped to provide the treatment the Commission deemed necessary. The degree of treatment to be provided was among the very first items of business once the Commission was organized. The report on the type of treatment proposed together with complete design data was submitted to the Ohio State Dept. of Health and returned approved July 11, 1949. Bids were received on Dec. 13, 1949 for contracts No. 1 and No. 2 covering fabricating, furnishing, erecting and testing of sludge filters and sludge incinerators, respectively.

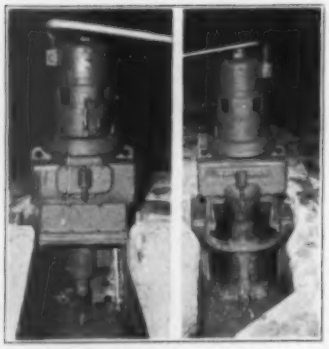
West Coast Progress

The new 245 mgd. activated sludge plant at Hyperion of the Los Angeles area is nearing completion. Partial operation is expected early in 1950. Water being precious, the activated sludge plant effluent will be sold for industrial purposes. The revenue from this is expected to practically pay for the operation of the plant. When this plant is really settled down to steady operation some very interesting papers should result. The instrumentation of this plant is such that not only will it be easy to operate and compute costs for almost all operations, but will also provide many data not readily available at most plants. Some of these extra instruments are those which give quantities of raw sludge fed to any tank by recording integra-



A Dorr Bio-filtration Plant in South Africa.

Serves the municipality of Potchefstroom, in South Africa's Transvaal, with population of 10,000. This plant is not a 1949 installation but is pictured to reveal that South Africa is sanitation minded, and likewise to reveal the care with which this plant is operated, maintained—yes, even "manicured". No wonder there are no objectionable odors around the Potchefstroom plant. W. J. Pietersen is Town Engineer.



Worthington's Solids Communitors
(A 1949 addition to the Worthington Line)

tors as valve settings are changed. Systematic sampling of sludge will allow easy calculation of solids balance—usually a slow laborious task.

The overall plan at San Francisco is moving ahead. The Richmond-Sunset improvements have been completed and the attack on the Bay pollution problem is next in order.

Portland has decided to remove its sewage from the Willamette and discharge it to the Columbia, where a very much greater dilution is obtained and a lesser degree of treatment required. This tunnel is 16,000 ft. long and will greatly relieve the pollution load on the sluggish Willamette. It will discharge Portland's sewage to the site of the new primary sewage treatment plant. The total cost is expected to be approximately $12,000,000.

INDUSTRIAL WASTES

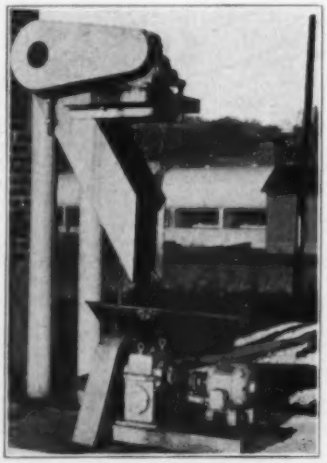
No better proof of interest in the subject of industrial waste can be given than two instances which occurred in 1949. In spite of recent changes to include "Industrial Wastes" in the name of many state or area member associations of the Federation of Sewage Works Assn., it remained for Ohio to be the first to give real equality of leadership such as alternating municipal and industrial members as Chairman of the Ohio Sewage & Industrial Waste Treatment Conference. This was done by a change in the Ohio Conference constitution in June, 1949. The other instance came in Boston at the meeting of the Board of Control of the Federation when it was voted unanimously to change the name of the Sewage Works Journal to "Sewage & Industrial Wastes," effective with the Jan. 1950 issue. A change in the name of the Federation itself was not quite so easy since it involved a constitutional chance which takes time. There seemed to be no doubt about the desire of the Directors of the Member Associations, to change the name to somehow include the name "Industrial Wastes." There seems little doubt that this will be effected in 1950.

Industrial waste research has been given an enormous impetus by the research section in Public Law No. 845 and the work done at the Environmental Health Center at Cincinnati, O. This, however, does not constitute even the major amount of work and interest.

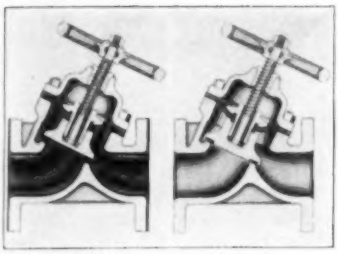
Purdue's Wastes Conferences

In the five Industrial Wastes Conferences held at Purdue University under the leadership of Don Bloodgood, Professor of Sanitary Engineering each one has been bigger and better and better attended than the former. The one held Nov. 29 and 30, 1949 was attended by 370 registered representatives of industries and municipalities together with some 87 of Purdue's graduate school and special students. Some 48 major papers were presented in the two-day meeting.

The combined efforts along industrial waste lines of some two dozen trade associations representing at least 15 major industries and many large individual industrial concerns, such as General Motors, Ford, DuPont, Atlantic Refining. American Cyanamid and American Viscose Co., just to mention a few, represent a total aggregate effort of tremendous importance and scope in this field. Many of these have been active in previous years, but 1949 saw a much greater interest and activity. If this progress



New Grit Collector, Washer and Elevator
(Developed by Walker Process Equipment Co. This unit is at Savanna, Ill.)



Crane Produced a New Diaphragm Type Valve
(Especially designed for sludges, slurries, sewages and industrial wastes.)

continues to accelerate, the enormity of the pollution abatement problem does not seem quite so staggering.

While usually treatment of industrial wastes costs money with little or no financial return, there are instances where through research, ingenuity and capital outlay, the wastes which formerly went into the sewer or streams to plague municipal sewage works operators or State Depts. of Health, are kept out of the sewers or streams and now bring a real profit to the industry involved. Perhaps it might be in order to briefly mention a few of these. The distilling industry has found a real profit in processing the distillery waste grains and evaporating the soluble wastes. The beet sugar industry has recently found it very profitable to operate their diffusion battery supply water as a closed system thus preventing loss of much sugar now recovered as sugar in the bag in the warehouses.

At Wheatland, Pa. a recovery process has been installed costing $500,000 to treat waste pickling liquor from the steel mills with zinc wastes from galvanizing plants.

Almost no company wants to state exactly what their profits are from by-products or waste recovery, but you may be sure that when elaborate plants costing hundreds of thousands of dollars are constructed after careful research, they promise more than an even exchange of dollars.

It is wrong, however, to approach this problem from a money making by-product point of view. Industry must consider its industrial waste treatment or disposal to be as much a part of the manufacturing cost as coal, power, labor or raw materials. If any profit can be obtained through research it should be considered as so much "frosting on the cake."

Another fine example of co-operation between a municipal sewage treatment plant and some industrial plants was reported by Groen[7]. In this case, the City of Dearborn used pickling liquor from the Ford Motor

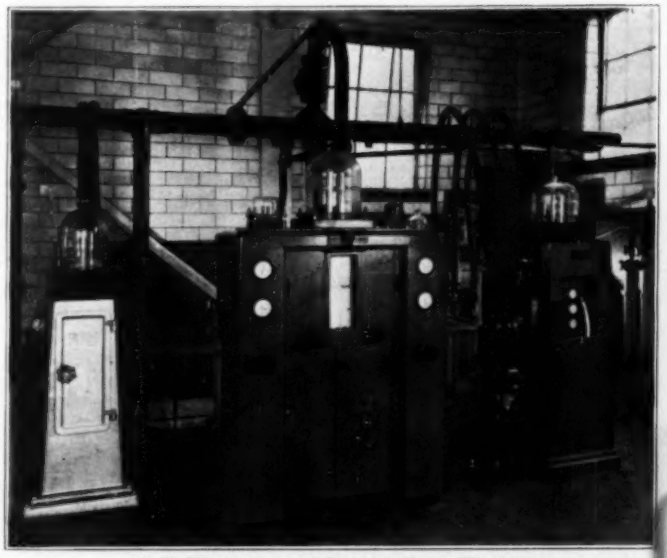
Co. and from the Murray Corporation for sludge conditioning prior to vacuum filtration. Lime which is the residue from the manufacture of acetylene has been used by the City of Dearborn for many years at a cost of 25 cts. per ton at the nearby lime pit. Hauling and labor costs bring this to $8.50 per ton of C_aO. Mr. Groen states that a saving of $1.50 per ton of dry solids or a total of over $20,000 per year was effected by using pickling liquor as a substitute for the costly ferric chloride besides solving a very thorny waste disposal problem for the manufacturers.

RESEARCH

Research in Sewage and Industrial Wastes has been continued with financing by the Federal Security Agency through the U. S. Public Health Service. This has been under the supervision of W. D. Hatfield, Chairman of the F.S.W.A. Committee on Standard Methods. This research program has been carried on at seven laboratories as follows:

No. 1—University of Wisconsin, M. Starr Nichols, Director
No. 2—University of Illinois, A. M. Buswell, Director
No. 3—Purdue University, M. G. Mellon, Director
No. 4—Rutgers University, Willem Rudolfs, Director
No. 5—N. Y. State Health Dept., F. W. Gilcreas, Director
No. 6—Mass. Inst. of Technology, C. N. Sawyer, Director
No. 7—Ohio State University, L. K. Herndon, Director

The problems being studied fall mainly into two groups; those having to do with B.O.D. and those relating to industrial wastes. In the first group are (a) the studies being made on improvements in dilution water and seeding technic (b) methods and standard solutiton against which the individual B.O.D. technic may be checked (c) manometric oxygen demand (d) studies of nitrifying organisms as applied to sewage purification and to the interpretation of B.O.D. data. The second group of problems relating to industrial wastes are again divided into two main divisions (a) a systematic method for the analysis of waters and sewage receiving metal plating and metal treatment wastes such as those containing Cd, Cr, Cu, Fe, Mn, Ni, Zn, etc. (b) those industrial wastes such as styrene, butadiene, sulfate and cyanide. In addition to the above listed laboratories, many other problems are being studied both in State and Federal agencies such as the Lawrence Experiment Station and the Environmental Health Center of the U.S. Public Health Service at Cincinnati, O. The F.S.W.A. Research Committee, headed by Dr. Willem Rudolfs, has been engaged in a series of toxicity studies dealing with (a) a review of the literature published during the last 25 years pertaining to the effect of toxic substances on sewage treatment, streams and B.O.D. (b) studies pertaining to toxic sub-



W&T's New Air-Operated Automatic Master Chlorinator

(This unit, which is in the South Yonkers, N.Y., Sewage Plant, is flanked on each side by two W.&T. Chlorinators of earlier periods. Many water plants can not boast as modern chlorination equipment.)

Compact Packing House Waste Treatment Plant

Features Dorr's "Duo Clarigester" which accomplishes primary settling, secondary settling of filter effluent and sludge digestion in a single unit. The "Duo-Filter" provides primary and secondary bio-filtration in a single unit with but one rotary-distributor. This plant serves the Reitz Meat Products Co. of Raytown, Mo. on an 80 x 100 ft. area.

stances present in industrial wastes which may affect stream and biological treatment processes and the effect of certain toxic substances on the B.O.D. method as presently employed (c) the literature as relating to the toxicity to fish and fish foods.

Since the at least partial awakening of industry some years ago to its share in the responsibility for treatment of its own industrial wastes, many industry-wide research studies are being made. Those started several years ago are being continued, such as iron and steel wastes as conducted at Mellon Institute under Senior Fellow R. D. Hoak; the pulp, paper and paperboard industries National Council for Stream Improvement, as directed by Harry W. Gehm; the National Dairy Assn., National Canners Assn., American Petroleum Institute, and many others.

The progress in some of the individual industries will be briefly stated:

American Iron & Steel Institute

The research program of this organization was started about 15 years ago, to correlate the work of the individual steel companies. Since 1938 the Institute has sponsored a research fellowship at Mellon Institute of Industrial Research, to study and develop the technical problems concerning the treatment and disposal of those wastes peculiar to the steel industry and to cooperate with state and federal agencies to achieve a feasible standard of purity in the receiving waters. This program has amounted to upwards of $250,000 in Mellon Institute alone with the examination of some 50 methods proposed for disposal of steel industry wastes and a dozen of those studied critically. Cost of treatment is the most serious drawback, but recovery of by-products offers some help.

Electroplating Wastes

The report of a recent survey by a committee of the American Electroplater's Society shows that nickel—83 per cent, copper—79 per cent, cyanide copper—74 per cent, chromium—73 per cent, cadmium—54 per cent and zinc—50 per cent were the electroplating operations carried on in some 84 plants responding to the questionnaire. Cleaning processes showed alkali cleaning—86 per cent, acid cleaning—81 per cent, ferrous—60 per cent and non-ferrous—48 per cent as the methods used in the responding plants. The reply to the questions on means of disposal of the plant wastes showed 73 per cent to sewers, 25 per cent to streams and 5 per cent to dry wells. (Several plants used more than one means of disposal.)

The Dairy Industry

This is one of the largest in terms of dollar sales of any of the divisions of agriculture having industrial waste problems. The dairy people early recognized the need for research into the various phases of the industry which include: Evaporated Milk Association, International Association of Ice Cream Manufacturers, National Cheese Institute, American Dry Milk Institute and American Butter Institute. These research problems have been handled through Task Committees since 1946 and their main objectives are (1) Distribution of information to members to reduce wastes within their own plants. (2) Studies of equipment design and plant layout to reduce amount of waste. (3) Studies of economically feasible methods of waste utilization. (4) Education of industry to measure and analyze their own wastes. (5) Education of members as to possible treatment methods and costs involved.

A full scale activated sludge plant has been operated at Belle Center, Ohio, to collect treatment information for the task committee.

Pulp & Paper Industry

This industry has been very active for a great many years in making studies of its members' wastes problems and the effect of all sorts of paper wastes on streams. Some five years ago the National Council for Stream Improvement of the Pulp, Paper and Paperboard Industries, Inc., was formed by a group representing more than 75 per cent of the entire industry. The membership is practically countrywide covering all the areas where stream pollution is a problem to members of the industry. The Council is now sponsoring cooperative research at several institutions. These research problems are financed by a budget of more than $150,000 per year.

Of a more specialized nature is that organization called The Sulphite Pulp Manufacturers Research League, Inc. Is is supported by eleven sulphite pulp producers. The principal objective of the League is to develop economically feasible methods for eliminating spent sulphite liquor as a factor in stream pollution. More than $500,000 has been spent to date on waste sulphite liquor treatment by sewage treatment methods and search for uses of this material.

Canning Industry

The National Canners Assn. has, for a dozen years or more, been a study and service organization for its members engaged in canning fruits and vegetables. Much study has been made of treatment and disposal of the industry's wastes. Two very good bulletins have been issued in cooperative research studies made jointly with the Wisconsin State Board of Health, Entitled "Methods of Treating Cannery Wastes" and "Cannery Waste Disposal Lagoons." Currently cooperative research studies are being made with both Purdue University and the University of Wisconsin. Money for some of this work has come from the Research & Marketing Act sometimes called the Hope-Flanigan Act of 1946, administered by the Dept. of Agriculture.

The subject of waste study and research should not be ended without giving especial recognition to the very exhaustive series of papers by Rudolfs and Trubnick, on Compressed Yeast Treatment[8].

In the making of the dress an amateur designer may find it hard to fit the pieces together, make the pattern match and sew up the seams without putting in bulges where they should not be and putting in the gathers and pleats where they should be. The author of this 1949 review has, no doubt, left out many meritorious things that should have been given recognition and probably should have curtailed emphasis in some places where it has been made. No one "garment" suits all persons, but it is hoped that some *Water & Sewage Works* readers may find this 1949 review of interest.

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J. W. Gittins Now Secy. Penna. Water Board

John W. Gittins has been appointed Secretary of the Pennsylvania Sanitary Board. Mr. Gittins, formerly connected with the Bureau of Engineering in the Wilkes-Barre office, has been acting secretary since the resignation last July of William Gorman. Mr. Gorman joined the U.S. Pub. Health Service as Asst. Basin Engr. in the New York office.

PURDUE'S FIFTH INDUSTRIAL WASTE CONFERENCE

IN the words of Arthur H. Niles, President of the Federation of Sewage Works Assns. (and Engr.-Supt. Sew. Treat. Works, Toledo, Ohio), "each of the Purdue Industrial Waste Conferences has been bigger and better than the last one, and the one held on Nov. 29-30, 1949, certainly topped the previous four by a wide margin." With a registration of 370 (plus 87 students), this conference indicated again the wide popularity of these meetings which have been scheduled about every fourteen months, and with fifty papers scheduled, for the two-day meeting, it was certainly the most ambitious program yet undertaken under the chairmanship of Don E. Bloodgood, Prof. of Sanitary Engineering at Purdue University.

As in the case of previous conferences, this one was held under the direction of the Purdue Univ. School of Civil Engineering, the Technical Extension Division of the University and the Indiana State Board of Health. Also, as in the case of the first four conferences, the fifth was held in cooperation with the Stream Pollution Control Board and the Conservation Dept. of the State, the Indiana Chamber of Commerce, and the Manufacturers', Dairy Products', Canners' and Brewers' Associations of Indiana as well as the Ind. Sect. of A.W.W.A.

The value of these conferences is attested by the fact that most of those attending came from industries having industrial waste problems. Further evidence of the popularity of these conferences is the fact that they draw attendance in large numbers from far outside the State of Indiana.

Because of the necessity of holding thirty-six papers on the second day of the meeting, it was impossible for a person to hear more than six papers out of that group, but credit goes to Prof. Bloodgood for scheduling the papers to start exactly on the hour, and then making sure that this schedule was followed. Thus, it was possible for a person to pick the six papers he most desired to hear, and to be sure that he would actually hear them. From the popularity of the meeting, and the interest shown in the papers, it appears that future conferences may well have to be extended to a three day meeting.

Welcome by Wiley

As in the past, Prof. R. B. Wiley, Head of the School of Civil Engineering opened the conference with his welcome to Purdue, and his review of work accomplished there.

From what has been said above, it is obvious that this report can not cover all of the papers presented. Even with the enlistment of several "assistant reporters" complete coverage can not be given. We have made the attempt, however, to present reviews of papers that are representative of the wide variety of subjects covered. The fact that some papers were not "covered" does not in any way indicate that they were any less important than those reported.

Hosts

R. B. Wiley
Head
Civ. Engr.
Purdue Univ.

D. E. Bloodgood
Prof.
San. Engr.
Purdue Univ.

Industrial Waste Research and the U.S.P.H.S.

"THE U.S. PUBLIC HEALTH SERVICE PROGRAM IN INDUSTRIAL WASTE RESEARCH" by V. McKenzie, Sanitary Engineer Director, U.S. Pub. Health Service, Cincinnati, Ohio.

Under Pub. Law 845 the industrial waste program is supported in three ways: (1) Grants to organizations or individuals through the National Institute of Health; (2) grants to states or to interstate commissions; and (3) direct engagement in research and field investigations by the Environmental Health Center at Cincinnati.

The work of the Environmental Health Center is divided between field studies, research studies, and consultation and training service to the states. Industrial waste studies are carried on through each of the major organizational sub-divisions of the P.H.S.: survey and investigation, research and development, and training section. Field studies consist of reviewing major industrial waste problems, conducting cooperative plant studies, and carrying on laboratory studies. The latter have been directed principally to analytical methods, with persistence studies, water quality studies, radioactive wastes, and toxicity tests receiving the most attention.

Ohio River Compact Commission

"THE OHIO VALLEY COMPACT COMMISSION LOOKS AHEAD," by Joseph L. Quinn, Chairman, Ohio River Valley Water Sanitation Commission, Terre Haute, Ind.

The immensity of the undertaking of the Ohio River Compact Commission can be realized from the fact that the area covered constitutes seven per cent of the whole United States. The River itself is 981 miles long and has 19 tributaries. In its basin live nearly 20 million people. Because there are 527 communities of 2500 population or more, and because there are 3200 groups or organizations interested in the problem, the Commission wisely chose to enlist the aid of all other organizations in the area in the attempt "to spread the gospel." Many industrial waste problems exist in the Ohio Basin, as well as numerous municipal disposal problems.

Mr. Quinn reported on the progress of the Commission during its first year (a short summary appears in Mr. Niles' annual review in this issue). Mr. Quinn also reported on the Commission's interest in reviving the Bailey Bill in Congress. It is planned to introduce a bill in the next Congress whereby any industry that has been certified by the U.S.P.H.S., and its state, can deduct the cost of industrial waste capital expenditures from its income tax over a period of five years.

The Commission is attempting to aid industry but does not ask for information on secret competitive industrial processes, but it can, does, and will continue to help industry before problems occur. One way in which the Commission hopes to aid industry is to help promote pilot plant work and bring the findings to the benefit of industry as a whole.

"HOW CAN INDUSTRY REGARD POLLUTION ABATEMENT IN THE OHIO RIVER VALLEY," by E. J. Cleary, Exec. Dir. and Chief Engineer, Ohio River Valley Water Sanitation Commission, Cincinnati, Ohio.

Mr. Cleary dispelled any idea that the Commission was or is attempting to socialize industry or to prevent further industrial expansion. (Ed. Note: Because of the wide-spread in-

terest in this subject, Mr. Cleary's paper will be printed in full in the March issue of *Water & Sewage Works*, and therefore will not be reviewed here.)

National Wildlife Federation

"THE NATIONAL WILDLIFE FEDERATION" by Carl D. Shoemaker, Conservation Director, National Wildlife Federation, Washington, D.C.

Mr. Shoemaker, a member of the Water Pollution Control Advisory Board under P.L. 845, told of the formation of the National Wildlife Federation, the adoption of the Duck Stamp, and the gummed stamps which are used to finance the work of the Federation, and many other phases of the Federation's work. Mr. Shoemaker favors pollution control, and expects the Water Pollution Control Advisory Board to accomplish what all conservationists want.

Antibiotics Waste

"WASTES FROM THE MANUFACTURE OF ANTIBIOTICS" by J. R. McMahan, Research Biochemist, Charles Pfizer and Co., Terre Haute, Ind.

Mr. McMahan spoke particularly about the wastes from a streptomycin plant. It was found that these wastes could be treated on a trickling filter but it would require a filter as large as that needed for a city of 15,000 persons. Experiments were also tried on chemical treatment. A small trickling filter plant with lagoons was available, chlorination in large doses removed the color of the waste and oxidized the B.O.D.

When it was found that the waste contained Vitamin B_{12}, efforts were directed toward byproduct recovery, and with the development of recovery processes, the waste has become easy to handle on the trickling filters available, and chlorine requirements have been reduced from 4000 ppm. to 50 or so.

Uses for Yeast

"USES FOR YEAST" by Elsie Singruen, Technical Consultant, Brewers Yeast Council, Inc., Chicago, Ill.

As indicated by the title of the paper, Miss Singruen reviewed all of the present day uses of brewers yeast, from dog foods, to pharmaceutical applications for the skin and bee food.

Frozen Food Processing

"STRENGTH OF WASTES FROM FROZEN FOOD PROCESSING" by J. A. Drake, Pub. Health Engineer, State Dept. of Health, Minneapolis, Minn. and F. K. Bieri, Asst. Pub. Health Engr., Div. Water Pollution Control, State Dept. of Health, Minneapolis, Minn.

In the case described, it was found that lagooning with sodium nitrate treatment was not sufficient. To reduce waste load, washing and blanching waters are reused. These observers noted that the B.O.D. values of these wastes were higher per case than in the case of ordinary canning, and therefore more sodium nitrate is needed to control odors from the lagoon. A 50 per cent satisfaction of B.O.D. by sodium nitrate is not sufficient, and these authors recommend a higher dosage at the beginning of the pack, with a tapering off later in the season.

During the course of the observations, studies were made on the relation of C.O.D. to B.O.D., and it was found that the sodium nitrate dosage could be controlled quite satisfactorily on the basis of the C.O.D. test.

Ohio River Compact

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Phenol Tests

"METHODS FOR ANALYSIS FOR PHENOL WASTES" by M. B. Ettinger, Scientist Officer, U.S. Public Health Service, Cincinnati, Ohio. Mr. Ettinger pointed out that the analytical results obtained for phenol depend on the test used for determining phenol, and more particularly on the screening process used to purify the waste and remove interfering substances. He described four screening processes and explained where and under what conditions each was most applicable.

Industrial-Municipal Cooperation

"THE FOUNDATION OF SUCCESSFUL INDUSTRIAL WASTE DISPOSAL TO MUNICIPAL SEWAGE WORKS" by W. H. Wisely, Exec. Secy. and Editor, Federation of Sewage Works Assns., Champaign, Ill.

(Ed. Note: This article will appear in an early issue of Water & Sewage Works.)

Pebble Phosphate Industry

"THE POSITION OF THE PEBBLE PHOSPHATE INDUSTRY IN STREAM SANITATION" by R. B. Fuller, Manager, International Minerals and Chemical Corp., Mulberry, Fla.

For the most part, the phosphate industry problems are unknown to the average person in industrial waste treatment. Mr. Fuller explained the size of the industry, told how phosphates are used mostly for food crops, and how phosphates were geologically laid down in Florida.

Research on the waste problems began in 1946, and have continued toward solving the problem of the tailings which contain colcoidal material and slimes (not biologic). The flotation process is used in the industry and much water is required; some 30,000 gpm. are now being reused. Storage of wastes seems to be the simple answer and at this one plant, 80 acres are used for storage of tailing, 460 for storage of sand, and 20 acres for water storage. Heavy rainfall (60 in. annually) adds to the problem of washing wastes into the rivers. Studies have been made on the effect of phosphate wastes on aquatic life in the ocean, and it has been determined that phosphate wastes had no connection with the "red tide" of dynaflagellates last year.

Iowa's Pollution Law

"DEVELOPMENTS IN INDUSTRIAL WASTE TREATMENT IN IOWA" by Philip Morgan, Professor of Sanitary Engineering, Iowa City, Iowa.

Prof. Morgan reviewed the Iowa Pollution Law of 1949, and stated that its purpose had been to allocate treatment capacity of streams, and to define pollution with stream use in mind. Prof. Morgan told how this law would apply to the various industries in the State of Iowa, and discussed the size of the industries and the problems involved.

The problem of tracing wastes was emphasized by the incident of 134 gal. of grasshopper poison (Chlordane) being dumped into a city sewer and killing all fish below the outlet. Some modern sleuthing brought to light the actual dumping of the poison and relieved local industry of any responsibility for the discharge of the lethal waste.

Fatty Acid Recovery

"THE REMOVAL OF FATTY ACIDS AND SOAPS FROM SOAP MANUFACTURING WASTE WATERS" by F. S. Gibbs, Pres., F. S. Gibbs, Inc., Boston, Mass.

At the Boston meeting of the Federation last October, one of the inspection trips included the waste treatment plant of the Proctor & Gamble Soap Mfg. Co., where Mr. Gibbs had installed a waste treatment system designed on the flotation prin-

ciple with finely divided air being used as the flotation agent.

At the Purdue Conference, Mr. Gibbs reviewed the development of the treatment unit from a pilot plant installation, first tried on white water waste from a paper mill. The accomplishment of the unit on the fatty acid wastes from soap manufacture were revealed both by photograph and by data showing that a concentration of 600 ppm. of fatty acids and soaps (of which 300 ppm. is undissolved) is reduced to approximately 10 ppm. of undissolved greases in the effluent. The unit has also been effectively used on pilot plant scale on wool scouring wastes.

Toxic Wastes

"Toxic Wastes in Municipal Sewages—A Review" by George E. Symons, Assoc. Editor, *Water & Sewage Works*, New York, N.Y. (This paper will appear in full in an early issue of *Water & Sewage Works*.)

(The following three papers were reported by A. Paul Troemper, Prin. San. Engineer, Illinois Sanitary Water Board, Springfield, Ill.)

Anaerobic Digestion

"Loading Factors for Anaerobic Digestion," by A. M. Buswell, Chief, Illinois State Water Survey Division, Urbana, Ill.

Dr. Buswell reported results obtained at various loadings on five digestion plant installations. A discussion of the theory and operating characteristics of the anaerobic digestion process was also given. It was pointed out that to avoid pollution it was necessary to remove the unoxidized carbon and hydrogen from wastes. This is normally accomplished by:

1. Plain sedimentation for the settleable material.

2. Bio-precipitation in the aerobic processes such as the activated sludge process where the hydrogen is converted to water and the carbon to carbon dioxide.

3. Anaerobic fermentation where the carbon and hydrogen are converted to methane (CH_4) and carbon dioxide (CO_2). In the absence of oxygen, the organisms present will attack the organic matter to form insoluble sludge, methane and carbon dioxide. Virtually any type of organic compound will correspond to this reaction to a greater or lesser degree except pure hydrocarbons. If oxygen is supplied the formation of methane is inhibited and carbon dioxide is largely formed.

It was pointed out that if an industrial waste contains 1 per cent or more volatile organic matter the possibilities of drying and selling the material should be investigated. The lower limit for which the anaerobic digestion process was applicable was given as 1 per cent (or possibly as low as 0.5 per cent) volatile organic matter in the waste. Below this concentration, the tankage requirements may make the process uneconomical. At least two-stage digestion should be provided for high rates of loading. In multi-stage digestion provision should be made for recirculation in every possible way. Agitation is one of the critical steps in the process since by this procedure, zones of unfavorable action can be seeded with healthy organisms from other zones.

The pH determination was considered not to be indicative of what

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will happen in digestion tanks. The only test which will give a good indication of impending difficulty in the digestion process is the volatile acids determination. Some plants may operate with 3,000 ppm. volatile acids over a considerable period; however, when the volatile acid and concentration gets over 2,000 ppm. the methane fermentation may stop. High volatile acid concentrations in the primary stage of a multi-stage digestion plant can be reduced by recirculation from the later stages (dilution). The most practical way to control high volatile acids in a single-stage operation is to stop or cut down the feed to the digester.

While many attempts have been made to isolate a pure culture of methane-producing organisms, none have yet been fully successful. However, a selected group of organisms can be developed and can be adapted to decompose almost any type of organic matter. The cost of the anaerobic digestion process is largely in capital rather than operating costs.

The operating results of several anaerobic digestion plants were presented.

Petroleum Refinery Wastes

"The Waste Disposal Program of the Sinclair Refining Co." by G. R. Arner, Plant Superintendent, Sinclair Refining Company, East Chicago, Indiana, was presented by James A. Fowler.

This paper reported the improvements made in the waste disposal system at the East Chicago refinery as a result of the lawsuit by the State of Illinois against the State of Indiana and a number of industries in the East Chicago area.

The refinery is located on a dead-end branch of the Indiana ship canal. At the time the court order was issued the refinery had a capacity of 55,000 barrels of crude oil per day. The process consisted of crude distillation, thermal cracking, polymerization, light oil treatment, and lubricating oil treatment. The residual crude oil was cracked to tars. Water usage was 34,000 gpm. All of this water was discharged to the canal and consisted of 22,000 gpm. of cooling water for which no treatment was provided, the remaining 12,000 gpm. being discharged through the old API separators. The present plant has a crude oil capacity of 85,000 barrels per day. Present waste volume discharged is 5,000 gpm. (expected to be reduced to 4,000 gpm.)

The improvement plan consisted of: (1) separation of sanitary sewage and industrial wastes with disposal of sanitary sewage to an existing municipal sewer system; (2) reduction of volume of industrial wastes by the extensive use of cooling towers in plant process operations; (3) provision of an American Petroleum Institute separator for the industrial waste effluent; (4) treatment of the concentrated wastes at their source before discharging them to the refinery sewer system.

The second provision of the plan was decided upon by refinery officials as an alternate to providing extensive additional separator capacity for the plant effluent. This procedure presented some problems since by reducing the volume, the concentration of solubles in the effluent was increased and therefore made necessary the reduction of wastes at their sources. Cooling tower capacity of 95,500 gpm. was provided, which was sufficient for all cooling and condensing needs in the refinery.

The third phase of the plan consisted of constructing a new API separator and revising the existing separators to operate in series with the new unit. The new unit is 130 feet long by 45 feet wide with a 6-foot water depth. It is capable of handling

7500 gpm. normally, however this may vary depending on the rate of flow, temperature and gravity of the oil. The effluent from the new separator is discharged to the old units for additional gravity separation of oil. No additional polishing of the separator effluent is provided.

The fourth provision of the plan consisted of a number of changes in the refinery processes. The light oil treatment plant was remodeled. Solvent extraction units were provided for treating lube oils in order to eliminate the acid treatment process. "Doctor treatment" of fractions was replaced by treatment in towers packed with rock and salt. This eliminated 1800 gpm. of waste which was high in sulfides and phenols. Waste caustic treatment was provided in packed towers by contact with air and steam. The sulfides present were converted to thiosulphates in the effluent. The process will strip all sulfides but will not remove phenols. No attempt has yet been made to recover or remove phenols. Approximately 1500 pounds per day of phenols are discharged. A total of $550,000 was spent by Sinclair Refining Co. in their pollution abatement program exclusive of the costs for cooling towers.

Dairy Wastes

"Methods of Study of Dairy Wastes Treatment by Aeration" by Nandor Porges, Chemist, Bureau of Agriculture and Industrial Chemistry, U.S. Dept. of Agriculture, Philadelphia, Pa.

Dr. Porges reported some of the research being conducted by that bureau at the request of the Task Committee of the Milk Industry.

The material used in the tests consisted of a 0.1 per cent solution of dried skim milk. Aerobic fermentation of this waste was investigated in the research project. Difficulty was experienced in finding a satisfactory laboratory test for control purposes. It was finally decided to use the chemical oxygen demand (C.O.D.) test, developed by Eldridge, as the most satisfactory control procedure. The C.O.D. of the fresh waste was found to be approximately the same as the 20-day B.O.D. A comparison of the chemical and biological demands was presented by the following table:

	B.O.D. — ppm. 20 Day	B.O.D. — ppm. 5-Day	C.O.D. — ppm. Total	C.O.D. — ppm. 40%
Skim milk sol.	1052	713	1056	636
Lactose sol.	516	331	519	431
Casein sol.	684	412	639	327

A comparison was also made between the synthetic waste used in the test and an actual milk waste on the basis of the composition of the milk solids.

	1% Raw Milk ppm.	.1% Dried Skim Milk ppm.
Fat,	390	9
Protein,	320	369
Lactose,	510	505
Ash,	70	81
Total Solids,	1290	964
Organic Solids,	1220	883

Pure culture fermentations were utilized in the tests. Five hundred-milliliter bottles were used for the tests. The quantity of air supplied originally was one volume of air per minute per volume of liquid fermented. This was later reduced to one-half to one-fourth volume of air per minute per volume of liquid. The air efficiencies were very small, amounting to 2 to 3 per cent utilized. The synthetic wastes were fermented with pure cultures in the ratio 20 ml. pure culture to 400 ml. of synthetic waste.

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A large number of cultures were used in the experiments. The results of a few were described. Using the organism bacillus polymyxa, a reduction in C.O.D. from 1050 to 700 ppm. was obtained in 96 hours of fermentation. Using the coli group or organisms from cow manure, no C.O.D. reduction resulted. Regular brewers yeast was also tried and would not produce satisfactory results. The most successful strain used was saccharomyces fragilis which produced a 93 per cent C.O.D. reduction (1050 ppm. C.O.D. at start) in a 96-hour fermentation period when nitrogen was supplied and the effluent centrifuged to remove solids. A 73 per cent reduction in C.O.D. was obtained in a 24-hour fermentation using the same procedure.

(The following two papers were reported by William A. Hasfurther, Sanitary Engineer, Ill. Sanitary Water Board, Springfield, Ill.)

"Abbreviated Aeration for Milk Waste Treatment" by S. R. Hoover, Eastern Regional Laboratory, U. S. Department of Agriculture, Philadelphia.

This was a continuance of the paper presented earlier by Dr. Porges and reported the results of areation studies of simulated waste in 30 liter aerator jars. Air was supplied at the rate of 15 to 18 liters per minute and the contents seeded with cultures taken from one of the Mallory oxidized sludge treatment plants. The test, using a 20 liter volume, lasted one month with successive rates of dosage each week of 1, 1, 1.5, and 2 liters per hour. Aeration detentions ranged from 20 to 10 hours.

The 0.1 per cent skim milk solution used as raw waste had a chemical oxygen demand of 1050 ppm. (roughly equivalent to the 20-day B.O.D.) and this was reduced, through aeration alone, 44 per cent at the low rate of feed and 40 per cent at the high rate. About 5 per cent of the aerator effluent was composed of bacterial cells, and, when it was put through a centrifuge operated at 1500 rpm. and these cells removed, the C.O.D. of the centrifuged effluent ranged from 40 to 88 ppm. Overall reductions were then 96.7 per cent at the low rate of feed and 91.7 per cent at the highest rate.

Further work is being conducted to determine optimum aeration rates, other types of seeding that will give good results, and economical means of centrifuging.

"A Plant for the Aeration of Milk Wastes" by William A. Hasfurther, Sanitary Engineer, Illinois Sanitary Water Board.

Studies were made by the Board on treatment and operation problems at the Dean Milk Co. bottling plant at Huntley, Ill. The treatment plant, which was put into operation last spring, consists of a collecting sump, a 13,500 gallon aeration tank (8 ft. deep and equipped with Walker Process impingement aerators), and a 2,100 gal. settling tank. The compressor capacity is 89 cfm. but part is utilized by the air lift return for sludge from the settling tank. Return sludge is not measured nor is the sludge that is wasted. Mixed liquor is returned at a constant rate to the wet well and effluent is returned through a float-controlled valve in amounts sufficient to keep a near-constant level in the sump.

Originally the plant was designed for aeration without the forming of an activated sludge but it was found that even at low rates of aeration a floc was formed. At rates where no floc formed, reductions were very poor. The plant was then changed by adding more jets and changing to an improved type and increasing the recirculating pump capacity to approximately 2 gpm. per cfm. air supplied.

Early results with insufficient and

old-style jets showed poor utilization of air, better results being obtained at low rates of air discharge than at high rates. These results were corroborated at another installation where large quantities of air applied through perforated pipe proved inadequate.

Under improved aerating conditions tests were made at partial and full plant loadings. With loadings of approximately 0.5 lb. 5-day B.O.D. per 1000 cu. ft. air applied, or 29 cu. ft. of tank volume per pound B.O.D., reductions of 96 and 97 per cent were obtained even though the consistency of the mixed liquor was controlled only by the color and settleability characteristics.

With loadings averaging approximately 0.9 lb. B.O.D. per 1,000 cu. ft. air applied, or 18 cu. ft. tank capacity per lb. B.O.D., equally good results were obtained when the mixed liquor was closely controlled, but poor reductions were obtained when the mixed liquor suspended solids content became too high. It was found that under even reduced loadings, when the total suspended solids content of the mixed liquor was greater than 3,500 ppm., treatment efficiency was poor.

With full loading, aeration tank dententions ranged from 5.7 to 10.3 hours, and settling tank detentions ranged from 1.5 to 2 hours. These were computed on the basis of average flow during the plant processing period.

Results of the studies indicated that best results were obtained when the suspended solids content of the mixed liquor was kept between 3,000 and 3,500 ppm., and that good diffusion is more important than the amount of air applied.

(The following paper was reported by A. J. Steffen, Sanitary Engineer, Wilson and Co., Chicago, Ill.)

Funds For Dairy Waste Research

"Methods of Instigating Research in Dairy Waste Under Research and Marketing Act" by E. W. Gaumnitz, Executive Secretary of the National Cheese Institute (Chicago).

Mr. Gaumnitz stated that $9,500,000 to $64,000,000 is available under the act for research, service and educational work, in marketing and research production utilization, distribution, nutrition, farm management and the like. Some of the funds are available for research in dairy waste treatment. One project, (Dr. Hoover's project, reported above) is receiving $25,000 during the current fiscal year for dairy waste research.

Mr. Gaumnitz stated that more dairy waste research projects should be submitted since the "Dairy Advisory Committee," of which he is a member, considers this field of number two priority for that portion of the funds allocated to dairy research. Some of these funds can be allocated to agricultural experiment stations, some to Federal Agencies, some to states on a "fund-matching basis" and some to private research organizations. Anyone interested, should contact Mr. Gaumnitz.

(The following three papers were reported by D. Paul Rogers, Acting Chief Chemist, Penna. Dept. of Health, Harrisburg, Penna.)

Sampling Devices

"Samples for Industrial Waste Surveys" by H. S. Kline, Industrial Hygiene Engineer, Frigidaire Div., G.M.C., Dayton, Ohio.

Samplers are defined as being devices for obtaining portions or indicating directly the chemical nature of the flowing wastes. Flow measurements may be made, depending upon the nature of the survey under consideration, by using the timing method, volume measurement, rectangular and V-notch weirs, Parshall and Venturi flumes, orifice meter, or the Venturi meter.

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Another important factor in an industrial waste program is the determinations of pH of the effluent of the waste. Wide range indicator papers, permanent color standards, permanent color glass discs, the more recent portable glass electrode, and the continuous recording type pH meters are well known means of making this determination.

The sampling method to be used must meet the requirements of the survey to be undertaken. Normal operating procedures of the plant must be known, in order to handle the disposal methods of the various different wastes—including toxic ones as well. Sampling may be accomplished by any one of the following method: Catch or grab sampling; scoop type devices of rotating spoon, revolving wheel with cups, bucket elevator; proportioning or chemical feed pumps; solenoid valve arrangements; measuring cup-distributing apparatus.

Three ingenious samplers designed by industrialists were described fully —one of the DuPont Co. Belle Works at Charlestown, W.Va. where a single solenoid valve, shallow well jet pump, timer operating for 10 seconds on a two minute cycle, and a 55 gallon drum are used to collect a composite sample for analysis. A standard integrating flow recorder and a timing relay operating off of a flow measuring device may be substituted in order to get a composite sample according to the flow.

The National Cash Register Co., Dayton, Ohio, has designed a sampler employing twelve solenoid valves, a pump, a special timer automatically opening a valve for prescribed periods of time every 15 minutes after a two hour composite is made, the timer changes to a second valve which operates also for a 2 hour period. Twelve composites are collected thereby in a day.

The Frigidaire's unique sampler involves lifting the waste 15 feet by compressed air. Electrically timed air pressure system, rubber reinforced metal disc, turntable directing, special sampling chamber, six 10 minute samples for the one hour composite to the proper bottle, automatic pH and flow recording instruments are some of its features. This sampler has been in continuous operation successfully for four months.

Packing House Waste

"Recent Research on Meat Packing Waste Treatment" by R. E. Stiemke, Prof., San. Engr., Penn. State College, State College, Penn.

In a recent publication the packing house wastes were listed fourth among the most important industrial wastes. The number of small slaughter houses in Pennsylvania amounts to 1500 and the amount of waste averages 100 gallons per hog killed and 300 gallons per steer.

The study was made of a pilot plant receiving wastes intermittently from the killings of 20 hogs and 4 to 6 cattle per day. These wastes have a B.O.D. of 600 ppm., a pH between 11 and 12, and an alkalinity of 1100 ppm. Septic tank and the trickling filter treatments have no future in producing a satisfactory effluent to be discharged into a stream. The activated sludge process has given a 91 per cent B.O.D. reduction. Sand filters will be successful in the Southern States especially when two filters are connected in series (60 to 90 per cent

reduction). Chemical treatment gives a 75 to 95 per cent reduction. Large quantities of chlorine in form of chlorinated lime or a high test hypochlorite are required before coagulating with alum. The cost for chemicals was found to be three cents per hog and fifteen cents per steer. Further treatment with bentonite adds additional cost of about 50 cents per 1000 gallons with a 40 per cent sludge.

Biological Yardstick

"THE BIOLOGICAL YARDSTICK AN AID TO SOLVING POLLUTION PROBLEMS" by R. Patrick, Curator of Limnology, The Academy of Natural Sciences of Philadelphia, Philadelphia, Penna.

Doctor Patrick described quite vividly that a disturbance in the biodynamic cycle of the animal and plant life at any one station of a stream indicates the degree of pollution at that time. Algae and the bacteria play a very important part in bringing back the stream to normalcy in which there is a balancing of the animal and plant life.

Multiplicity is the keyword in a stream survey—chemical and physical tests are made to obtain the general characteristics of the stream and experts of each of the taxonomic groups study their own samples of the stream at the same time in order to make a classification according to their natural relationship. These groups are as follows: 1. The pollution algae and rotifers. 2. Tolerant worms etc. 3. Protozoa. 4. Non-pollution algae —diatoms, etc. 5. Sensitive rotifers, clams, etc. 6. Insects and crustaces. 7. Fish.

A *healthy station* of the stream is one with a balance of organisms. Each biological group has a number of organisms equivalent to the average for a healthy station.

A *semi-healthy station* is one that is slightly unbalanced. Some of the groups have an increased number of organisms and some have a decreased number from the average for a healthy station.

A *polluted station* is one with a definitely upset balance of organisms. The first three groups have increased to as much as two-fold, with a decrease of about one-half for the fourth to sixth group and the seventh group absent.

A *very polluted station* is one that is definitely toxic to animal life with no species in most of the groups and a very low number of species only in the first, third and fourth groups.

An overall biological pattern is thus determined. To determine the effect of any industrial waste upon a stream, it is necessary to have three sources of information. First, chemical and physical characteristics are determined; second, the dilution method to eliminate toxic effects of wastes is used, and, third, the rate of recovery from the pollutional effects in the stream.

Miss Patrick described in detail the biological study on the Conestoga basin in southeastern Pennsylvania and stated that this type of measure is sound in principle for developing of healthy water conditions with reference on stream standards instead of effluent standards. The biological measure may be used alone or with other yardsticks as a certain aid to solving pollution problems.

Biological Yardstick

"BIOLOGICAL INDICES OF STREAM QUALITY" by W. Van Horn, Research

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For any one set of stream conditions it is possible to determine the degree of pollution by a study of the organisms found in the stream. A change in environment changes the organism population. Oxygen, one of the most important environmental factors, exercises a selective action on aquatic organisms. Toxic substances tend to kill everything. Inert material usually acts in a manner similar to toxic substances.

Summarizing the results of previous published investigations, the water fungi have been used to identify the zone of recent pollution, maggots to define the zone of septic conditions, and worms to show the zone of recovery. In the first zone, where oxygen is reduced, less sensitive forms of fish and bottom organisms tend to replace normal species, and sewage fungi appear. In the septic zone, tubifex, rattailed maggots and other forms not using oxygen are reported to be found but the author has failed to find maggots in swift-flowing streams. In the last zone, where oxygen is increasing, carcasses of water fungi may be found and forms with varying degrees of tolerance appear beginning with bloodworms and sucker fish.

Stream velocity affects plankton and so a pollution index based on plankton alone would not be reliable. All flora and fauna should be studied to obtain reliable evaluation of pollution.

Toxicity tests in the laboratory offer another method of obtaining stream information but stream conditions cannot be duplicated exactly and so these tests are subject to question. Laboratory toxicity tests are most likely to give a reliable indication if pollution is caused by an industrial waste alone.

Studies of the minimum lethal concentration of kraft paper-mill wastes using sensitive organisms have made it possible to predict with certainty the probability of a fish kill downstream from a particular mill using data on the waste supplied by that mill. This has been particularly valuable in the case of new mill installations.

Biological studies are of special value where pollution enters streams in slugs leaving no chemical trace but providing the biologist with an abundance of evidence of it having passed downstream.

Biological measurements should not replace chemical and other methods but all should be used together with intelligence and common sense tempered with experience.

(The following three papers were reported by R. D. Hoak, Senior Fellow, Mellon Institute, Pittsburgh, Penna.)

International Conservation

"CONSERVATION ON AN INTERNATIONAL BASIS" by H. H. Michaud, Asst. Prof. in Forest Conservation, Purdue University, Lafayette, Ind.

Prof. Michaud was a delegate to the United Nations Conference on Utilization and Conservation of Natural Resources at Lake Success. The object of this group is the mobilization of the science and technology of the whole world for human betterment through modern methods of use and conservation of natural resources. He pointed out that no country has fully utilized the possibilities inherent in scientific development of its resources.

Education in agricultural technology is a slow process, but, despite backward practices, more food is raised per acre in Europe than in this country. He discussed the ways in which natural balances can be upset by the inability to recognize the end

results of various actions. For example, slaughter of leopards permitted the baboon and bush pig to multiply in South Africa, creating a more difficult problem. Similarly, killing off lions encourages the hyena to multiply, and driving out the coyote on our western plains caused a great increase in the prairie dog population with a resultant increase in crop damage. In the same fashion he touched on wasteful lumbering operations and land use, erosion control and irrigation as soil conservation measures, and pollution abatement. He concluded by saying that conservation is a state of mind, and that the standard of living cannot be increased except on the basis of a continuing yield of natural resources.

Water Conservation

"Conservation of Water Resources" by S. T. Powell and A. C. Wilson, Chemical Engineers, Baltimore, Md.

Mr. Wilson pointed out that rapidly diminishing water resources require more rigid regulation than in the past. Potential curtailment of production; loss of intangible values; and inhibition of development in many areas have led to greater emphasis on reuse of water. About half of the country depends on ground water. In some areas, deep wells are receding at a rate of 23 feet per year and exhaustion of ground water is having a marked effect on industrial development. Some improvement in recharge has been noted where wells have been shut down for varying periods. Artifical recharge from reservoirs has been practiced, but the recharged water is warmer than normal. Water recharged should be sanitary, and compatible with the underground supply. Intrusion of sea water is a serious problem in some sections. Along the Southern California coast the rate of withdrawal is twice the recharge rate. Depletion of ground water has forced industry to resort to surface supplies in many areas. Use of sewage plant effluents as a source of industrial water is being studied following successful use at Sparrows Point. The cost of supplemental chlorination by Bethlehem Steel is 1.73 cents per 1000 gallons, exclusive of interest and amortization. The largest single industrial use of water is for cooling, and efficient cooling towers can conserve 95 per cent of the water requirements. Deposition of encrusting salts from recirculated water can be controlled by chemical means. Water can be conserved by practicing successive cooling, where water can be carried from low temperature exchangers to successively higher temperature exchangers. Study of rinsing operations has reduced water requirements by as much as 80 per cent where weak rinses are reused.

Pickling Liquors

"Disposal of Spent Pickling Liquors" by T. F. Reed, Chem. Engr., U.S. Steel Corp., Pittsburgh, Penn.

No general solution to the pickle disposal problem is yet available, or in prospect. This is not due to lack of diligence on the part of industry, because large sums have been spent on research and there is an extensive literature covering this work. Any treatment plant should be reasonably independent of steel and coke manufacture for the obvious reason that production may not be controlled by the vagaries of such an installation.

The process chosen must be economical, and as flexible as possible.

Programmers

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The use of chlorinated copperas in water, sewage and industrial waste treatment may expand, but such use must compete with alum and ferric sulfate. Use of reclaimed free acid from pickle liquor has not been favored in the past, but efficient filtration and adequate reduction of ferrous sulfate content can provide a reusable acid. Many proposed processes use a relatively expensive reagent to upgrade pickle liquor, therefore any fluctuations in the cost of such a reagent would be magnified on the balance sheet. The problem of disposing of pickle liquor economically is not completely hopeless, but neutralization is at present the only practical method, and this is very costly.

(The following paper was reported by M. R. Golly, San. Engr., Ill. State Dept. of Health, Springfield, Mo.)

Coke Wastes

"Preliminary Investigation of Factors Influencing the Characteristics of By-Product Coke Wastes" by H. H. Black, Chief, Industrial Wastes Section, Public Health Service, Cincinnati, Ohio.

The magnitude of the by-product coke waste problem is shown by the fact that about 15 per cent of all coal used in the United States is carbonized in coke ovens. Approximately 170,000 tons of coal are charged to about 13,000 ovens per day.

Sources of waste disposal problems in coke plants may be divided into five major categories:

1. Characteristics of the coal used.
2. Coke oven design.
3. Temperature and rate of coking.
4. By-product recovery processes.
5. Plant operation and maintenance.

Only semi-bituminous or eastern bituminous coal is generally satisfactory for coking purposes. Low moisture, sulfur and ash content and high fixed carbon are desirable characteristics. The volatile content, preferably as high as possible, affects gas, tar, ammonia, and benzol production directly, and so affects the waste problem. Different coals may be blended to obtain the desired characteristics in the coke or the by-products. Preoxidation during coal storage changes coal characteristics and hence the by-products and wastes.

Coke ovens are designed to heat, in the absence of air, all the coal in the oven to a uniform temperature throughout the charge. The normal design provides a chamber about 18 inches wide by 12 feet high by 40 feet long and holding 18 tons of coal. Arrangements for heating and other construction details vary. A patented self-sealing door is used on some ovens.

Coking temperature, usually 925° to 1050° Centigrade, affects quantity and character of by-products. Normally, as temperature increases gas production increases, tar decreases, light oils increase up to about 900° Centigrade and then drop slightly. Important wastes such as phenols, creosols and pyridine decrease markedly as the temperature rises. The coking action in the oven is believed to occur largely in a vertical zone or plane parallel to the oven side walls about one-fourth-inch thick, referred to as a "plastic zone." In each oven two plastic zones form at each side wall and move toward the oven center. Coking time is proportional to the square of the width of the oven.

The semi-direct method of ammonia recovery, which produces a smaller volume of ammonia liquor, is more commonly used than the indirect system. Phenol recovery, the recovery problem of most importance where plant wastes discharge to streams utilized for drinking water supply, is related to the coking temperature and the oxygen content of the coal. An average of about 0.55 pounds of phenol per ton of coal coked is reported. The cyanides,

which are highly toxic, can be hydrolized to ammonium compounds. Pyridine production amounting to about 0.15 pounds per ton of coal may add to waste disposal problems.

In plant operation and maintenance, leaking pumps and pipelines, surface drainage, still maintenance, and disposal of emulsion type wastes are troublesome.

Cyanide Waste

This paper was reported by W. A. Hasfurther, Principal Sanitary Engineer, Illinois Sanitary Water Board, Springfield, Illinois.

"TREATMENT AND DISPOSAL OF CYANIDE BEARING WASTES" by John E. Tarman, Director, Consulting Division, W. H. and L. D. Betz, Philadelphia, Pennsylvania.

Results were presented for operating plants where differences in manufacturing procedures and discharge conditions made variations in treatment necessary. Plant A discharges treated wastes to sewers tributary to a suburban treatment plant. Small metal parts are cleaned and plated, using acid, alkali, Cu., Al., and Cd. Wastes are segregated; cleaning wastes treated for oil removal by aerating, acid cracking and skimming, and then combined with the plating wastes.

Combined wastes are batch treated in 5500 gallon tanks. Calcium hypochlorite is added to give a residual of 2 ppm. of chlorine, pH is adjusted to about 8, and ferric sulfate added for coagulation. After settling the supernatant is drained slowly to the sewer and sludge is drawn to lagoons. Lagoon supernatant is returned to the raw wastes. Cyanide content is reduced from 85 to 0 ppm.

Plant B required complete treatment since no sewers were available. Processing consists of acid and alkali cleaning and plating with brass, bronze, nickel, and zinc. Cyanide bearing, plating, and miscellaneous wastes are treated separately. Cyanide wastes are pumped to concrete tanks equipped with agitators. Gaseous chlorine is added to give a residual of 2 ppm. plus, and an automatic pH recorder and caustic feeding machine maintain the pH slightly about 8.0. Mixed and settled batches are tested for cyanide before supernatant is drained to a storm sewer. Cyanide concentration of the raw ranges from 200 ppm. down and always has been reduced to zero without need for retreating.

Plant C expanded and produced a new type of waste not acceptable to the municipal sewer. Discharge is above a public water supply and recreational area. Operations include acid and alkaline cleaning of metals, surface preparation, and enameling. When the cyanide bearing solution is sprayed on, some CN is oxidized to cyanate and chlorine must be added to treat both radicals. The dosage is calculated on the basis of CN and an equal amount is allowed for the cyanate.

Programmers

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Cyanide bearing wastes are pumped through a gas chlorine feeder, caustic being introduced into the pump suction. When the reaction is completed the wastes are combined with other wastes and this mixture is treated with dry lime and alum for removal of other objectionable substances. Supernatant is discharged to the stream and sludge to a lagoon.

In Plant D, a ferro manganous blast furnace, waste gases had been scrubbed, thus dissolving cyanide, and scrubbing liquors treated with ferrous sulfate and ponded. Scrubbing was discontinued to permit dry reclaiming of the solids in the gas. Cooling waters were still discharged to the lagoons but seepage through the slag dikes contained ferro cyanide which in the stream was converted to toxic cyanide by the action of the sun. This condition was eliminated by putting cooling waters through cooling towers and bypassing the lagoons.

The need for a study of the problem at hand to obtain maximum economies was pointed out.

Entertainment

Besides a full share of industrial waste papers, those attending this conference were treated to three illuminating and highly entertaining talks by members of the Purdue Faculty. At the Tuesday evening banquet, Prof. W. O. Forster of the History Department told of some of the diplomatic maneuvering that went on in the early history of this country. Forster's amusing citations seemed to belie the famous crack of Will Rogers that we had never lost a war or won a diplomatic conference. If history is taught today as Prof. Forster presented it that night, then there are a lot of men in the industrial waste treatment field today who wish they were studying history now, instead of making it.

Also at the Tuesday evening banquet, Director of Students George E. Davis, presented some readings from James Whitcomb Riley's poems. This being the centennial of Riley's birth, Davis' readings were highly appropriate, and Mr. Davis is noted throughout the midwest, not only as expert in the presentation of Riley's poetry, but as an authority on Riley himself. For persons not previously acquainted with the great Hoosier poet, Mr. Davis, made him live again. For those, who in their youth were raised on James Whitcomb Riley, it was a thoroughly delightful trip through nostalgia.

At the Wednesday luncheon, R. B. Stewart, Vice President of the Purdue University, explained the Land Grant College System and how it works. He also presented some highly interesting information on the effects that may come from Federal aid to education.

"Fred" Crane Now Buffalo's Commissioner of Public Health

Frederick W. Crane, General Manager of the Buffalo (N.Y.) Sewer Authority for the past three years resigned that position on Jan. 1 to accept the appointment as Commissioner of Public Works of the City of Buffalo.

A graduate of Cornell University, Mr. Crane has been associated with the City of Buffalo as a Civil Engineer for 27 years, having been a structural engineer in the Department of Buildings and Sewer Dept. prior to 1938 when the Sewer Dept. was taken over by the Buffalo Sewer Authority.

In 1944 while on the engineering staff of the Sewer Authority Mr. Crane was co-author with Dr. George E. Symons of the "Buffalo Formula" for special charges for industrial wastes.

In 1946 Mr. Crane left the engineering staff of the Sewer Authority to become City Engineer in Buffalo and a year and a half later returned to the Sewer Authority as General Manager, which post he relinquished to become Commissioner of Public Works.

BIO-OXIDATION AT CHULA VISTA, CALIFORNIA

A TWO-STAGE PROCESS DEVELOPED ON THE WEST COAST

by

W. T. WRIGHT

Consulting Engineer*

LOS ANGELES, CALIF.

CHULA Vista, California, has become the first community to solve its sewage treatment problem through the installation of a modern plant using Dual-Stage Oxidation Process, a recent West Coast development.

Chula Vista is located on the San Diego Bay, approximately 10 miles south of San Diego. It has a present population of 15,000. There are a number of industries, including a citrus cannery, a chemical plant, and aircraft manufacturing units. Exceptionally fine climate, room for both industrial and domestic expansion, adequate water supply, together with proposed municipal harbor developments, presages an excellent growth for Chula Vista during the coming decade.

This community has always been progressive in the matter of sewage treatment. Wastes from the city are discharged into the southern end of San Diego Bay. Over 20 years ago when virtually all wastes entering the Bay (including those from the city of San Diego) were untreated, the City of Chula Vista installed an Imhoff Tank to provide primary treatment of sewage prior to its disposal into the Bay. In 1941 San Diego installed a primary treatment plant. Since that time virtually all wastes entering San Diego Bay have been given partial treatment.

An Imhoff Tank proved adequate for Chula Vista until the defense program and the war brought a marked increase both in population and industry to this little city, resulting in a far greater sewage load. As a temporary expedient during the war a new 40 ft. diameter digester equipped with a P.F.T. Floating Cover was installed to provide complete digestion of sludge from the digestion compartment of the Imhoff Tank.

Another Forward Step

Shortly after the war Chula Vista officials again took a forward step in sanitation and decided to augment their existing treatment facilities by the addition of a larger plant of modern design.

Early in 1947 the author's firm* was retained to investigate the sewage treatment requirements and to design a suitable plant which, when combined with the present plant, would have sufficient capacity to care for the needs of the city during the next 20 years.

A study of available data disclosed that the sewage flow per capita averaged 70 gallons. The sewage was exceptionally strong and contained appreciable quantities of H_2S. It was further determined that the existing plant could produce satisfactory primary treatment when handling up to 0.225 MGD from a population of 3,000.

Following a careful study of all factors it was decided that the new plant should be designed in accordance with the data summarized in Table I.

Although the desired quality of effluent as given in Table I was somewhat higher than that delivered by the present primary plant, it was felt that the improved treatment was justified in view of the present trend of

Table I

Basic Design Data

Design Population (Equiv. Basis)	20,000
Design Average Flow	1.50 MGD
Design Peak Flow	2,300 GPM
Raw Sewage Characteristics	
Temperature	70° F.
Hydrogen Sulphide	20 ppm
Suspended Solids	300 ppm
5-Day B.O.D.	250 ppm
Effluent Characteristics (Sought)	
Hydrogen Sulphide	0 ppm
Suspended Solids	75 ppm
5-Day B.O.D.	100 ppm

*Kistner, Curtis & Wright, Engrs., Los Angeles, Calif.

Fig. 1—General View, Chula Vista Sewage Treatment Plant

the State of California to increase minimum treatment standards.

In determining the preferred process of treatment for the new plant, a study of the various methods of modern treatment was made. Choice was narrowed to consideration of intermediate high-rate filtration and the then newly developed "Dual-Stage Bio-Oxidation Process." Careful investigation indicated the Bio-Oxidation Process to be capable of producing an effluent superior to that required. Estimates showed the Bio-Oxidation Plant to be appreciably less expensive in first cost than the high-rate filtration plant and no more costly to operate. Accordingly, a decision was made to proceed with the design and construction of a Dual-Stage Bio-Oxidation Plant.

Since this method of sewage treatment is relatively new, it is felt that a brief description of the process will assist in better understanding the design and operation of this plant.

The "Dual-Stage Bio-Oxidation Process"

The Dual-Stage Bio-Oxidation Process is a development of Process Engineers, Inc., of Los Angeles and San Francisco. In general, it consists of subjecting the sewage to treatment in two "Process Oxidators" arranged for series operation. The Process Oxidator is a combination aeration and settling unit designed for a circular tank. Aeration and internal sludge recirculation is carried out in a circular center aeration compartment, followed by up-flow sedimentation in the annular outer compartment. Solids which settle in the outer compartment are raked to the center compartment for either removal or for revivification by aerated recirculation with the flow of screened sewage entering the tank.

The design of the "Oxidator" is exceedingly flexible. Long or short aeration periods can be used. The unit will allow the employment of intense aeration or gentle air flocculation at will. The internal sludge recirculation provision is adjustable and permits the return of a small quantity of concentrated sludge, or larger volumes of their sludge or mixed liquor in quantities in excess of the flow entering the tank if and when desirable.

The degree of treatment afforded the sewage is a function of the design of the component parts of the Oxidators in the flow sheet, and the quantity of air used. At times chemicals may be employed to effect a higher degree of treatment with reduced aeration, should this prove advantageous.

The design of the Chula Vista plant was based on the following anticipated results:

Dual Bio-Oxidation (Without Chemicals)
- Removal of Suspended Solids.....80%
- Removal of 5-Day B.O.D.....60%

Dual Bio-Oxidation (With Chemicals)
- Removal of Suspended Solids.....90%
- Removal of 5-Day B.O.D.....80%

As noted above the anticipated removals without chemicals would meet the basic design requirements. However, it was decided to include provisions for chemical addition ahead of the secondary Oxidator, to be used in event either the load increased or higher treatment standards should be required in the future.

Plant Design Costs

The Flow Sheet which was adopted for final design is shown on Figure 3.

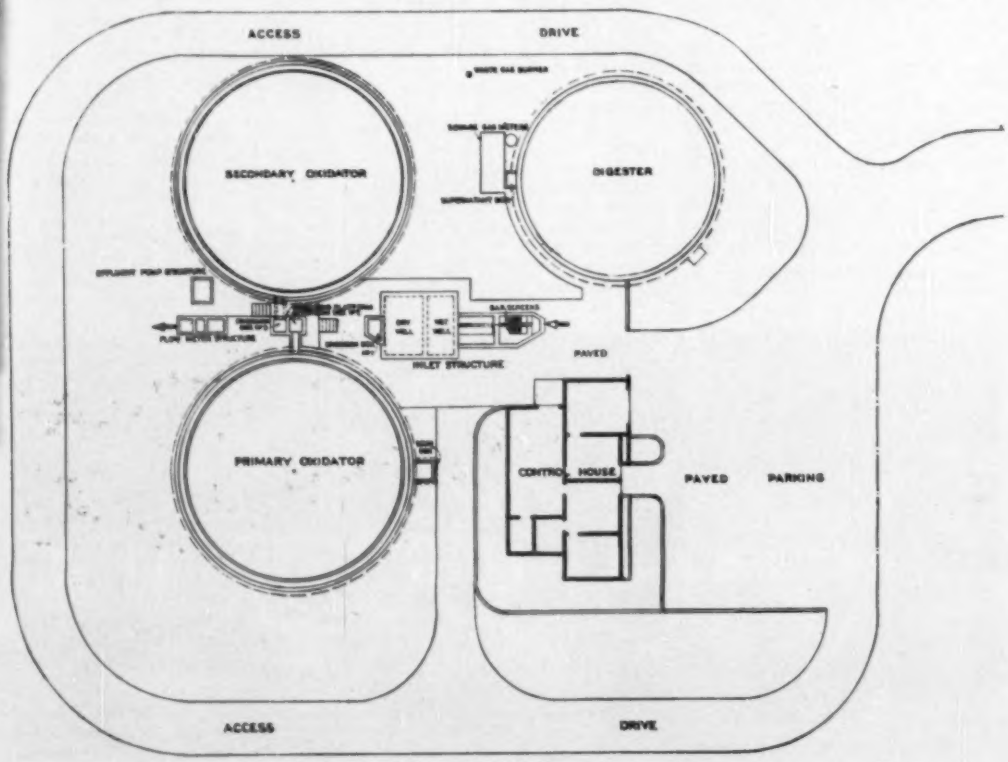

Fig. 3—General Plan, Chula Vista Sewage Treatment Plant

The plant in general consists of the following major units:

(a) 2—Bar Screens, 1′-9″ wide x 2′-6″ deep, hand cleaned

(b) 2—Grit Chambers, 1′-9″ wide x 14′-6″ long x 2′-6″ deep, hand cleaned

(c) 1—Wet Well; 6′-4″ wide x 13′-8″ long x 7′-0″ maximum water depth

(d) 1—Primary Oxidator; 55′-0″ diameter x 10′-0″ S.W.D., with aeration compartment diameter of 28′-0″.

(e) 1—Secondary Oxidator (same as primary)

(f) 1—Sludge Digester, heated; 45′-0″ diameter x 27′-0″ S.W.D.

The design included automatic prechlorination at wet well for the control and removal of hydrogen sulphide. A chemical solution tank and feeder was provided to permit the introduction of either iron or alum coagulating solutions ahead of the secondary Oxidator. To insure raw sewage pumping in event of power failure, the largest of the raw sewage pumps normally driven by an electric motor may also be driven by a standby gasoline engine through a combination gear drive.

Bids were called on the project March 30, 1948. The low bid was submitted by James W. Huntley at the figure of $185,493.00, for the complete plant and with a deduction of $16,000.00, for eliminating the vacuum filter and filter cake conveyor. In order to keep the cost at a minimum, the city decided to postpone the installation of the filter and conveyor. Consequently, the award was made at the figure of $169,493.00. The total cost of the plant as finally accepted by the city was $171,095.00, which included some extra work.

It is considered that this cost of approximately $8.55 per capita or $114,063.00 per million gallon capacity is unusually low, considering the volume of the flow and the high degree of purification which is possible with this plant.

The plant was completed one year later and was opened for public inspection April 30, 1949. Table II lists the names of the various items of mechanical equipment installed in the plant.

Table II

MECHANICAL EQUIPMENT INSTALLED IN PLANT

Pumps

Raw Sewage
Type—Fairbanks-Morse Vertical Non-Clog
Capacity—
1—4″ Motor Driven @ 500 gpm
1—4″ Motor Driven @ 800 gpm
1—5″ Combined Motor and Engine Driven 1,000 gpm
(Engine—Buda)

Primary Sludge Pump
1—Marlow Simplex Plunger Pump—Cap. 75 gpm

Secondary Sludge Return Pump
1—4″ Fairbanks-Morse Vertical Close-Coupled Non-Clog 300 gpm Sewage Pump

Digested Sludge Recirculation
1—4″ Fairbanks-Morse Vertical Close-Coupled Non-Clog 200 gpm Sewage Pump.

Chlorination

1—Wallace & Tiernan Master Automatic Visible Vacuum Chlorinator, Type MASV-M
1—Fairbanks-Morse Platform Scale

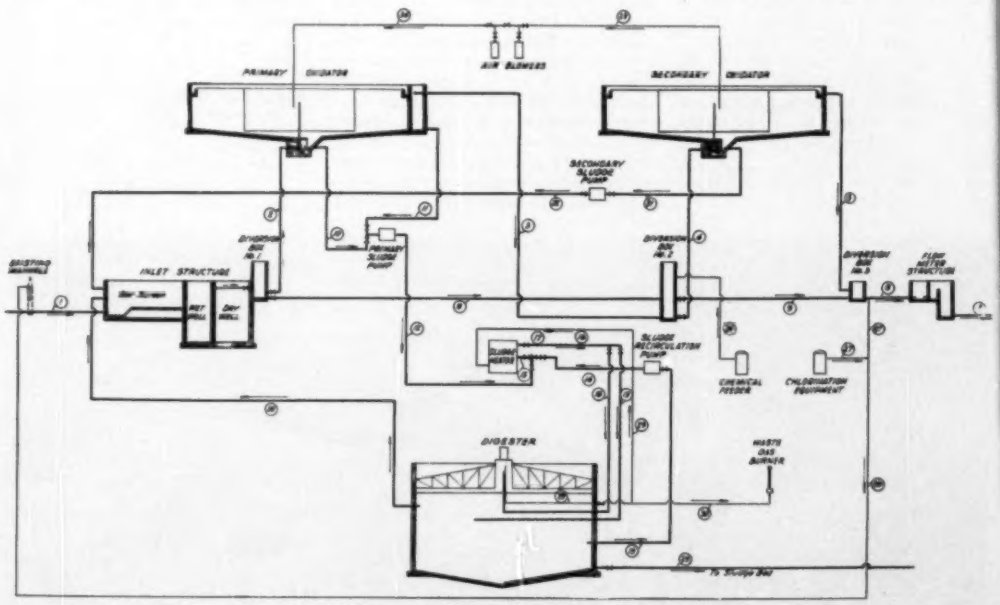

Fig. 3—Flow Diagram, Chula Vista's Two-Stage Bio-Oxidation Plant

Piping Arrangements.

(1, 2)—Raw Sewage to Inlet Structure, to Diversion Box No. 1, to Primary Oxidator.

(3, 4)—Settled Sewage, Primary Oxidator to Diversion Box No. 2, to Secondary Oxidator.

(5-7)—Aerated Effluent, Secondary Oxidator to Diversion Box No. 3, to Flow Meter Structure, to Ocean Outfall.

(8, 9)—Crude or Settled Sewage Bypass, Diversion Box No. 1 to No. 2, to No. 3, to Chlorination Station, to Outfall.

(10-12)—Sludge and Scum Lines, Primary Oxidator to Primary Sludge Pump, to Sludge Heater, to Digester.

(13-19)—Sludge Recirculation Lines, Digester to Recirculation Pump, to Heater, to Middle or Upper Zone of Digester.

(20)—Supernatant Liquor, Digester to Inlet Structure.

(21, 22)—Sludge Return Line, Secondary Oxidator to Sludge Pump, to Inlet Structure.

(23)—Digested Sludge Line, to Sludge Bed.

(24, 25)—Air Lines, Blowers to Primary and Secondary Oxidators.

(26)—Chemical Feed Line, Chemical Feeder to Diversion Box No. 2, to Secondary Oxidator.

(27, 28)—Chlorine Solution Lines, Automatic Chlorinators to Effluent Line or Raw Sewage.

(29, 30)—Sludge Gas Lines, Digester to Sludge Heater and Waste Gas Burner.

Oxidators
1—Process Oxidator (with skimmer) as Primary Unit
1—Process Oxidator as Secondary Unit

Blowers
2—Roots-Connersville Motor Driven Blowers, each with 120 cfm capacity

Sludge Digester
1—Pacific Flush Tank Co. Floating Cover

Digester Heater
1—No. 170 Pacific Flush Tank Digester Heater & Heat Exchanger with automatic controls

Gas Control Equipment
Flame Arresters, Waste Gas Burner, and Drip Traps by Pacific Flush Tank Co.

Chemical Feeding Equipment
1—300 gallon rubber lined solution tank complete with Lightnin' Mixer
1—Chemical Proportioning Pump by Proportioneers Inc., Providence, R. I.

The general plan of the plant, as built, is shown as Figure 2.

Figure 1 is an overall view of the plant under normal operation. A close-up of the primary treatment portion of the plant, including the raw sewage pumps, chemical feeding units, and primary Oxidator, will be seen in Figure 4 and Figure 5 is a close-up view of the secondary Oxidator, which reveals the effective aeration obtained in the center compartment.

Delays in the completion of the outfall sewer postponed initial plant operation until July 14, 1949. On that date sewage flow was turned in and the plant has been in continuous operation since that time.

Operating Procedure and Results

The present operating procedure involves pre-chlorination of the sewage ahead of the raw sewage pumps for odor control and hydrogen sulphide removal. The raw sewage pumps then deliver the crude sewage direct to the primary Oxidator, from which point the sewage flows by gravity to the secondary Oxidator. A portion of the sludge from the secondary Oxidator is delivered to the primary Oxidator on an intermittent basis for concentration with the crude solid prior to pumping to the digester. Under present operating conditions no chemical treatment is employed, since it has been found that the removals are adequate without chemical treatment at this time.

The past few weeks of operation have disclosed some interesting features. Floating scum on the surface of the primary Oxidator is practically non-existent, and there is no scum whatever on the secondary. The absence of scum is particularly noteworthy, inasmuch as during the summer months in California most sedimentation units experience difficult scum problems. The internal aeration feature appears to be very efficient in controlling scum formation and in keeping the contents of the tank in a fresh condition. It has also been found practical to produce a thick sludge in the primary tank even when returning secondary sludge for concentration. Tests have indicated a solids content in the combined sludge, comparable with that usually produced in primary clarifiers in this area. It is worth observing that combining aeration and sedimentation in a single structure does not reduce the solids concentration of the resultant sludge.

Although the plant is not yet being operated with laboratory control, some test information has been obtained to determine the present degree of treatment. Table III furnishes operating

Table III
OPERATING RESULTS
(Without Chemical Treatment)

	8/7/49*	8/10/49*	8/17/49*
Fats and Grease—ppm			
Raw	25	30	50.6
Effluent	7	10	7.2
% Removal	72.0	66.7	85.8
Total Solids—ppm			
Raw	1466	—	1510
Effluent	1228	—	1000
% Removal	16.2	—	33.8
Suspended Solids—ppm			
Raw	251	263	384
Effluent	57	61	72
% Removal	77.3	76.8	81.3
Settleable Solids—ml/L			
Raw	8.0	—	13.0
Effluent	0.1	—	0.2
% Removal	98.8	—	98.5
Combined Raw Sludge			
% Dry Solids	4.8	3.85	5.7
% Moisture	95.2	96.15	94.3
% Volatile	81.9	76.3	79.4
% Ash	18.1	23.7	20.6

(*All tests made from 24 hour composite samples.)

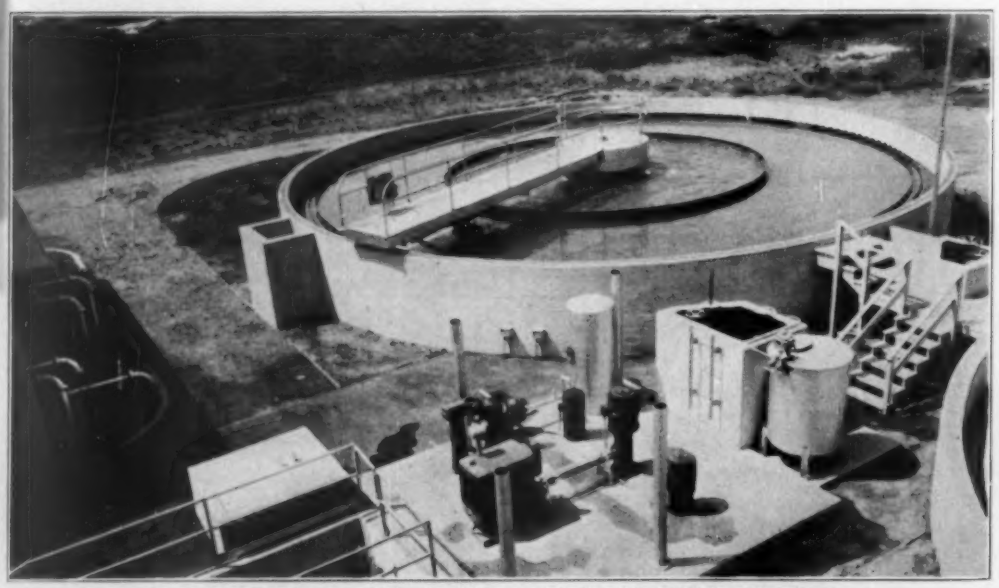

Fig. 4—A Near View of the Primary Treatment Portion of the Chula Vista Plant
Primary Oxidator, Raw Sewage Pumps, Chemical Solution Tank and Feeder Between Primary and Secondary Oxidators.

results based on 24-hour composite tests for three days during the month of August. These tests do not represent a true picture of the overall removals which should be possible with this plant, since the various units were not completely balanced at the time of the tests. However, it will be noted that the sewage treated is on the strong side and an excellent removal of both settleable and suspended solids was obtained. Unfortunately, facilities did not permit running B.O.D. tests on these samples. From the settleable solids tests, it will be noted that the plant is effective in an almost complete removal of all *settleable* solids. Attention is also further called to the dry solids content of the combined raw and secondary sludge. Although the volatile content is on the high side, the percent of dry solids is comparable with most sludges removed from *primary* treatment plants in California.

Short period tests were run with various types of chemicals and it was found that excellent coagulation with consequent higher removal of solids can be obtained by reasonable dosages of alum, ferric chloride, or ferric sulphate. Operating difficulties with the proportioning chemical pump precluded running a test of several days duration with coagulants, but this is planned for a later date.

On September 30, a full day's test was run using a dosage amounting to approximately 30 ppm of $FeCl_3$. Laboratory tests on samples of the sewage showed the following results on suspended solids.

Raw Sewage	271 ppm
Final Effluent	24 ppm
Percent Removal	91.3

These tests were conducted during the daylight hours and the sewage flow averaged approximately 1.5 MGD. During this test with coagulants, it was interesting to note that excellent floc formation was obtained with the iron coagulant in the presence of air mixing and internal sludge recirculation.

Fig. 5—Close-up of Secondary Oxidator
Reveals Effective Aeration Obtained in Center Compartment. Settling Takes Place in the Quiescent Outside Ring.

Based on the past few weeks of operation, we consider the present treatment without chemicals to be extremely satisfactory, meeting fully the present requirements. From the short period tests with coagulants, we are convinced that we will be able to appreciably increase the degree of purification, if ever required, at a nominal additional cost for chemicals.

Acknowledgment

We wish to acknowledge the assistance and cooperation given us by the State Department of Public Health through their Senior Sanitary Engineer, Judson A. Harmon, and Assistant Sanitary Engineer, Arthur Rheinhardt. The development of new methods of treatment looking toward better results at less expense can only be accomplished by the support of public men who have an interest in progressing toward better processes and methods. This is equally true of Mayor Lorenz C. Koester, Councilmen Aaron Riesland, Dwight Kidder, Ralph Dyson, Dudley Nashold, Administrative Officer Herbert V. Bryant, and City Engineer Harold Foster, of Chula Vista.

We believe our combined efforts have added another forward step in sewage treatment.

President Names 7 Member Water Resources Comm.

Prompt Action Requested in Reporting to Congress

Perhaps the water shortage being experienced by a number of municipalties across the nation, and especially that of New York City and Northern New Jersey, had an influence in causing President Truman to issue an executive order and name a Temporary Water Resources Commission which is asked to make a prompt survey of the water supply situation in the U.S. and report its recommendations to the present Congress for legislative action.

Although the establishment of this Commission had been under consideration for some time for determination of the most equitable handling of water allocation problems of the west — notably the Colorado River waters, over which Arizona and California have been fighting a "cool war" for sometime—the domestic water shortage situation brought the matter to a quicker decision in the President's office.

The President has asked the Commission, headed by Morris L. Cooke, Philadelphia engineer, to complete its work by Dec. 1, 1950, but to make recommendations on the more urgent issues for earlier action by the Congress. Serving with Chairman Cooke are Leland D. Olds, former Federal Power Comm., of New York; R. R. Renne, President Montana State College; Lewis W. Jones, President Univ. of Arkansas; Gilbert White, President, Haverford College (Pa.); Sam. B. Morris, Chief Engr., Los Angeles Dept. of Water and Power; Paul S. Burgess, dean of College of Agriculture, Univ. of Arizona.

Amongst the matters to be given study by the Commission are: (a) priority considerations in water resources programs affecting states and municipalities; (b) criteria for evaluating the feasibility of water resources projects; (c) desirable legislation on changes in existing laws relating to the development, utilization and conservation of water resources; (d) the character and extent of possible Federal participation in major water resources programs or projects.

AIR FLOW MEASUREMENTS

EXPERIENCES WITH A NEW TYPE AIR METER AT THE WARD ISLAND SEWAGE TREATMENT PLANT

by

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Div. of Sewage Disposal
DEPT. OF PUBLIC WORKS
NEW YORK CITY

THE Ward's Island Sewage Treatment Works, operated by the Dept. of Public Works of the City of New York, located in the shadow of the Hell Gate and Tri-Boro Bridges, occupies 52 acres. Originally designed to treat 180 million gallons daily, the present flow averages 240 mgd. Sewage is pumped by six 90 mgd. raw sewage pumps. There are six motor-driven blowers for furnishing air to the activated sludge process. Four of these are rated at 42,500 and two at 28,500 cu. ft. of air per minute. All electric power is purchased at a daily cost of about $1.000 and 60% of this power is used for the production of compressed air. The air from these blowers is measured by Venturi Meters calibrated for normal values of 100°F. temperature, 7.5 psi. and 80% relative humidity. The meter readings have been of importance in checking efficiency of the blowers, determining leaks and controlling the air-sewage ratio.

The sewage flows by gravity from eight primary settling tanks through two 96 in. pipes to the aeration tanks, then to the final settling tanks. The 16 aeration and 32 final settling tanks are separated by the North and South Galleries (Fig. 1) in which are the control valves, meters and return sludge pumps. On one side of the gallery building a mixed liquor channel feeds the aeration tanks; on the other side another channel conveys the return sludge to the return sludge pumps which pump it to the mixed liquor channel where it is mixed with the incoming settled sewage. Primary sludge and excess activated sludge are pumped to storage tanks for final disposal by barging to sea in specially designed sludge vessels.

While this article will discuss flow metering installations of the plant, it will deal particularly with a new type of air meter.

Each of the two 96 in. pipes conveying settled sewage to the aeration tanks is split into two 72 in. branches, provided with a 72 in. x 36 in. Venturi Tube connected to a Builders Type M Totalizing-Indicating-Recording Instrument. The latter is actuated by floats in open vertical float pipes into which a small back flushing stream of water is continually introduced at the top end. This type of installation has proven to be extremely satisfactory from the standpoint of accuracy and minimum required maintenance. The flow of the sewage to each battery, consisting of four tanks, is controlled by a large gate valve. Beyond this valve the return sludge is added, which is metered by a 36 in. x 26 in. Venturi. The mixed liquor then flows into the channel that feeds four aeration tanks in parallel, through the aeration tanks and then over weirs through 42 in. Venturi's to the final settling tanks. This meter is similar in design to the 72 in.

*Engineer-in-Charge, Instrument Maintenance and Repair.

Fig. 1—South Gallery Ward's Island Sewage Treatment Plant
(Showing Air Control Valve on Right; Flow Instruments on Left.)

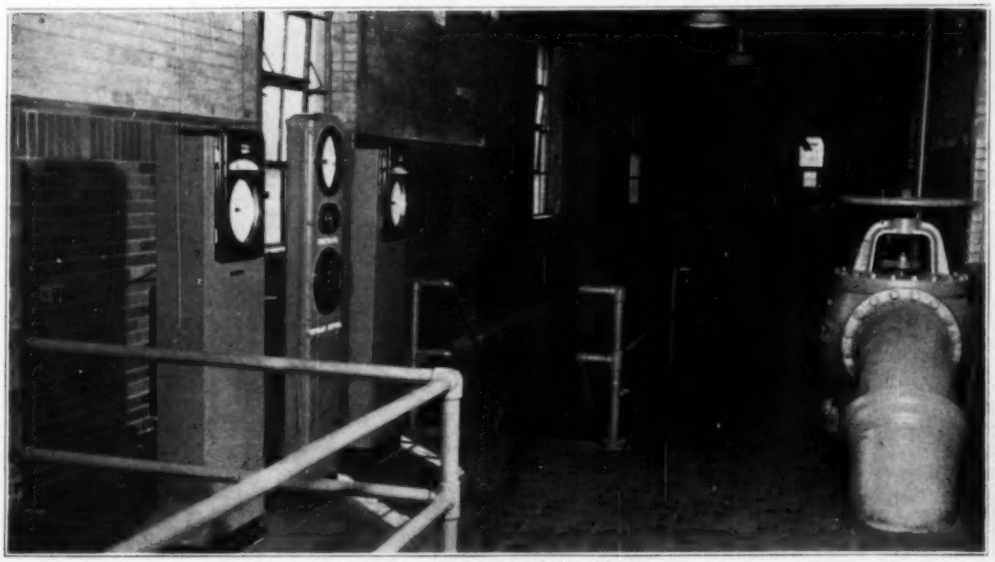

Fig. 2—Flow Instruments at Closer Range
(Original Sewage Meter, Flanked New Type Air-Flow Meters.)

The six large blowers discharge air into a common 66 in. header which is divided into two 42 in. branches tapering into 24 in., extending the entire length of each gallery basement. At the middle of each aeration tank is a riser containing a 24 in. x 12¼ in. Venturi Tube. The inlet and throat pressure pipes lead to the rear of the instrument panel on the floor above—see Fig. 2. At the upper end of each riser on the operating floor a 24 in. x 18 in. x 18 in. tee valve is set to control the desired rate of flow of air to each tank. Finally, the air flows through two 18 in. headers to the porous plates in the bottoms of the aeration tanks. Fig. 1 shows one of the tee valves and nearby Venturi Instrument arrangement, and provides a good idea of the length of gallery and general arrangement. At the left is the Venturi Totalizer-Indicator-Recorder for sewage (the float pipes at rear are visible); at the right, the new Flo-Watch Airmeter. A close-up view of the Recorder is shown in Fig. 2. The graduated range of the 42 in. sewage meter is 0-33 mgd.; of the air meter, 0-13,000 CFPM.

In Fig. 2, the middle and right-hand instruments are those mentioned in the preceding paragraph but at the left a "Flo-Watch" has been added which is connected to a 10 in. x 6 in. Venturi Tube from the 42 in. air header. It indicates and records the rate and totalizes the air supply to the return sludge and mixed liquor channels mentioned. The range is 0-4,000 CFPM.

The Importance of Metering Accuracy

With the tremendous strides made in sewage treatment and with various modifications of the activated sludge process being investigated and developed by members of the New York City Dept. of Public Works, such as "step aeration" and "modified aeration," the author considered it his duty, as Instrument Engineer to provide the Plant Operating Engineer with the best equipment obtainable for accurate measuring of sewage and air, to make sure the instruments are operating correctly at all times so that dependable data can be obtained.

One of the difficulties encountered during the investigation of the various processes was the extreme flow ranges: a meter graduated for one set of conditions would be unsuitable for another; either the rate of flow would be in the very low range of (if not below) the meter scale, or else much in excess of the maximum graduation of the instrument. Criticism of the air meter was frequently voiced, it being forgotten that it was designed originally for specific conditions. With this situation in mind, J. C. Thorensen, Development Engineer of Builders Iron Foundry, Providence, R. I., was asked if it would not be possible to furnish a meter of more universal application, with minimum costs and parts for ranges of 0-10,000, 0-30,000 and 0-60,000 CFPM air flow, also to have an outside source of pressure for its operation rather than the usual differential. It was learned that such a meter was already being developed. In due time a pilot instrument was furnished Ward's Island by the manufacturer for test under actual working conditions. After a long series of tests the new instrument was found to meet the various requirements of our air measuring problem.

The New Type Air Meter

Fig. 3 shows more clearly the elements of the transmitter. Flow through the Venturi Tube (in gallery below) creates a differential pressure in diaphragm chamber (D) and the resulting movement of diaphragm forces beam (B) to move upwards and close the air bleeder valve. The pressure from the external air supply consequently is built up and an equivalent head of mercury displaced from fixed mercury well (W) to suspended mercury well (W^1). This causes the beam to move downward slightly until the air pressure at (A) balances the differential pressure. A single small pressure line conveys the resulting air pressure to the actuating syphon bellows diaphragm (G) of the instrument. Due to the bell-like shape of the interior of the mercury well (W), this pressure is directly proportional to the rate of flow.

For adapting the instrument to a different flow range, or for connection to a different size of Venturi Tube, it is simply necessary to move the suspended mercury well to a new position on scale beam (B).

Having demonstrated the wide range of this meter, all that became necessary was to remove the older instruments, change pressure piping slightly and connect to the new instrument. It is readily adaptable to large variations in differentials. Sensitivity of response is easily regulated by changing the opening of two small orifices in the air connections. To date, after twenty months in use, twenty such meters have been shown to be able to cope with large variations in flow and very little maintenance has been required. Standard practice is to make sure, at intervals, that the two small orifices are clear by inserting the fine wire provided, set the special test weight on beam balance and check the response of the indicator, chart and totalizer dials. The instrument is a standard Builders "Flo-Watch" with mechanically-driven integrator, eliminating the necessity of planimetering charts. The design lends itself readily to transmitting readings electrically to distantly located instruments.

Concerning accuracy, this subject is always apt to be controversial. Accuracy tests were made on each instrument when placed in service. A sensitive draft-type manometer was connected to the Venturi Tube and, applying A.S.M.E. flow formula, the instrument was run through its full scale range: at each rate the comparison was within ½ per cent, fully as accurate as our needs required.

For a small investment, the present instrument can be readily converted to different flow ranges; or, to put it another way, it combines many instruments in one, an important consideration in present day sewage plant design. Flexibility to meet changing conditions is one of the outstanding characteristics. Others are: Small cost for changing range, scale and charts. It can be used on gas, air, sewage or sludge. The adaptability of this meter for numerous kinds of service requires only a small number of spare parts to be carried in stock.

In my opinion, this meter is a distinct step forward and long needed, particularly in the sewage field.

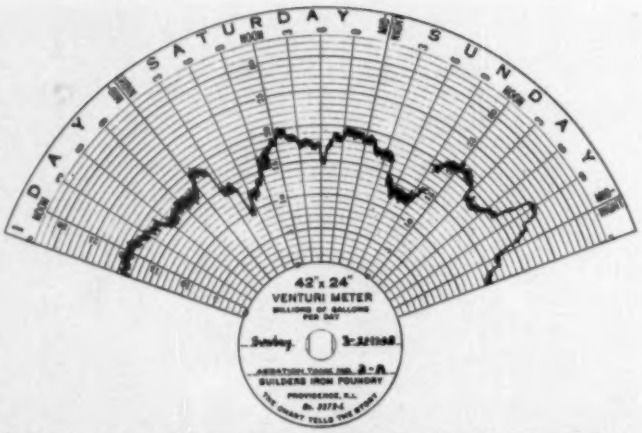

Fig. 4—Meter Chart, Showing Variations in Sewage Flow Through an Aeration Tank

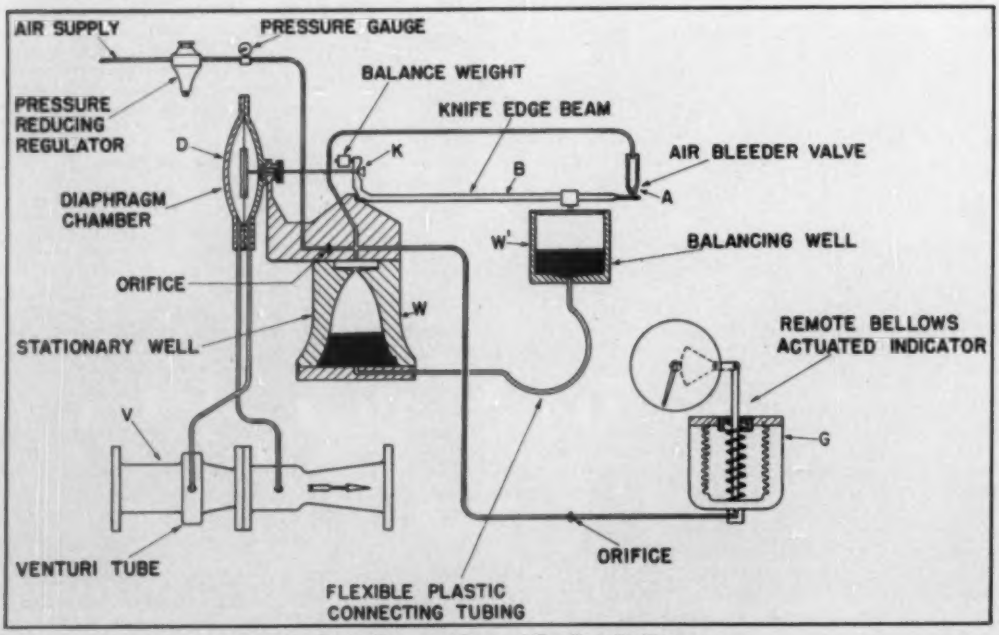

Fig. 3—Elements of Design of New Type Air Meter

PRECONDITIONING AND DIGESTION OF SEWAGE SLUDGE

*The Sixth of a Series of Articles from the Operator's Viewpoint**

Digestion Tank Troubles

by

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The Chester Engineers

PITTSBURGH, PENNA.

IN this final section of the series, it is proposed to spend some time on digestion tank troubles: odors, scum, supernatant liquor and foaming.

Odors

Hydrogen sulfide is a very odorous gas as all operators know. It was previously shown that the digestion of proteins produced small amounts of this gas. Intermediate products that may be formed during early stages of the digestion of proteins are the mercaptans of which ethanethiol, C_2H_5SH, is an example. These mercaptans are even more foul smelling than the hydrogen sulfide. It is they, together with indole, C_8H_7N and skatole, (other intermediate products) that are largely responsible for the noisome odor of septic partially digested sludge.

It is to be noted that both the mercaptans and hydrogen sulfide contain sulfur. In fact, that element seems to be the one most responsible for odors about sewage plants in general, as well as about digesters in particular. Even mineral sulfates are broken down to hydrogen sulfide during digestion, so any increase in sulfate content due to addition of ammonium sulfate or the use of alum or iron sulfate coagulants in chemical precipitation plants, may increase H_2S production. [31] [32]

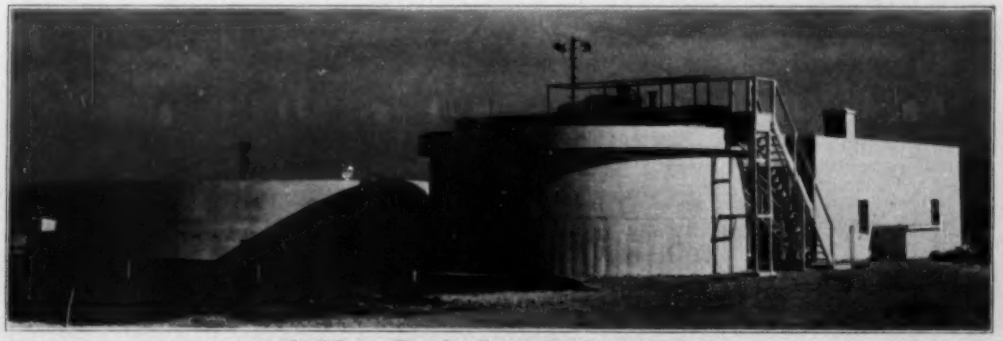
The Author

Fortunately, all hydrogen sulfide formed does not escape. The gas dissolves in water forming H^+ ions and HS^- ions, as well as undissociated H_2S. If iron, or some other heavy metallic ions are present, (and they almost always are) they will combine with the HS^- ions to produce insoluble compounds such as ferrous sulfide, FeS, which hold the sulfur in suspension, in an inert condition, and so use up part of the H_2S formed. It is this ferrous sulfide formation that apparently causes most of the change in sludge color, (from grey to black), that takes place during digestion.

As previously stated, the remaining dissolved sulfides consist partly of HS^- ions and partly of undissociated H_2S. As shown in Standard Methods[30] the relative proportions of these two depend upon the pH. At a pH of 7.6, only 11 per cent of the dissolved sulfides are undissociated gas; at pH 6.6, this proportion is increased to 56 per cent, and at a pH of 6.0, it is 83 per cent. Since it is only the undissociated H_2S that can escape into the atmosphere and cause odor nuisance, the desirability of avoiding acid conditions is evident.

To summarize, digestion odors may be practically eliminated by (a) maintaining a high alkalinity and a thoroughly digested sludge in open tanks, (b) avoiding *sudden* changes in digester loadings or temperatures that might cause temporary upsets, and (c) possibly avoiding the use of sulfates for chemical coagulation or digester control. I am not too sure that

*This article completes the series. The previous five parts appeared in 1949 in April, May, July, Sept. and Nov.



Small Sewage Plant, Last Frontier Hotel, Las Vegas, Nev.
(At right Dorr "Clarigester" providing sedimentation and digestion in a single tank.)

item (c) is of much real importance, although, theoretically, it is correct.

Scum

Scum formation is objectionable because (a) it occupies valuable space in the digester which could otherwise be utilized for effective digestion, (b) it interferes with gas ebullition, causing the gas to escape in "belches" that blow out seals, etc. rather than as a fairly uniform stream and, (c) because it may foul supernatant liquor or even plug supernatant drow-off piping. It is not uncommon to find solids concentrations of 10 to 20 per cent in the scum layer. The scum is usually high in undigestible material such as cellulouse (match sticks, rags, straw, etc.) hair, mineral oils, greases and rubber goods. However, it also contains such digestible material, particularly animal and vegetable fats and soaps; it is usually low in digestible nitrogenous material and so may be subject to acid digestion.

Usually, the tops of digesters are less effectively insulated than the remainder of the tank, and so may be colder. This condittion is particularly conductive to scum formation. Even if there is no temperature stratification, scum troubles are more prevalent at lower temperatures than they are at 95°F. The best solution for scum abatement is the circulation of alkaline sludge or supernatant, from a lower point in the tank, on to the scum in the vicinity of the gas dome. This breaks up the scum, forces some of it down, eliminates temperature stratification, and reseeds the scum which may have become so acid that active digestion has ceased.

The addition of ammonia gas, or ammonium compounds, to the circulated liquor, may be quite effective. Although ammonium sulfate has been used for this purpose[m] it would appear that the use of almost any other ammonium compound would be less likely to create odors. Scum formation is frequently an indication of overload in which event it will disappear if the tank loading is decreased. If all attempts at control fail, it will be necessary to eliminate or reduce the amount of undigestible material entering the digester. Screenings may be buried instead of being ground and returned to the raw sewage. Skimmings from pre-aeration and primary sedimentation basins may be dewatered either on sand beds or in special concentration tanks[m] and burned, or buried. At Butler, Penna., skimmings are pumped to the secondary digesters instead of to the primary digester; it seems to work satisfactorily.

Supernatant Liquor

Throughout this paper the term "supernatant liquor" (sometimes called digester overflow liquor) is applied to the thinnest material that can be withdrawn from single stage digestion tanks, or from the final tanks of multi-stage digestion systems, to make room for the daily additions of raw sludge to the digestion system. There may be thinner liquor in the digestion tanks, but if piping isn't so arranged that it can be withdrawn, we can't call it supernatant liquor under the above definition. "Good" supernatant contains 0.2 per cent total solids, or less. "Bad" liquor contains 0.5 per cent total solids or more; it may contain as much as 2 per cent, or even more, solids and, in reality, be a thin sludge.

Walden, N.Y.—Stacey-Klonne Gas Holder

Bad supernatant may result from either overloading the digestion system, or from excessive accumulations of digested sludge stored up awaiting removal to drying beds. If due to the second cause, the obvious solution is to speed up drying by one means or another. If due to the first cause the solution is to either reduce the loading by better concentration of raw sludge, or speed up digestion by applying one, or more, of the principles previously expounded.

Frequently it will be found that the quality of the supernatant liquor can be improved by withdrawing it at a lower rate. (In some cases the operator may have little control over the withdrawal rate but, at least, he can pump raw sludge into the system as slowly as possible.) Recently the Pacific Flush Tank Co. has developed a "supernatant selector"[m] [n]. This device not only makes it possible to withdraw liquor at a slow uniform rate, but also insures that the thinnest liquor in the tank is withdrawn. It could be installed in many existing digesters but probably won't be.

A peculiarity of all bad "supernatants" I have seen is that although they will not separate in the digesters, they will do so once they are withdrawn. In many cases part of the solids rise to the surface while others settle to the bottom, but at least, there is a clearer liquor in between. Apparently the sludge solids contain entrained gas that cannot escape under the pressures prevailing in the digester. When the pressure is reduced the gas either escapes, allowing the solids to settle, or expands and causes them to float. Return of this bad supernatant liquor to the raw sewage washes out the gas so that the solids will settle, but seeds the sewage with anaerobic bacteria, or enzymes, that may cause gasification and flotation of the mixed sludge and interference with secondary treatment methods, particularly the activated sludge process. In some cases even "good" supernatant liquor has a similar effect. Despite the fact that sedimentation and skimming will reduce the solids in a bad supernatant, such treatment alone cannot eliminate the deleterious effect of the liquor on primary sedimentation processes.

At the Grove City, Penna. activated sludge plant I found that either good or bad supernatant could be returned directly to the aeration tanks with less ill effect than resulted from its return to the raw sewage. I believe the same thing has been found to be the case at Ann Arbor, Mich., and some other activated sludge plants. The disadvantage of returning a bad digester tank liquor was that it increased the amount of activated sludge to be wasted.

A logical treatment for bad digester overflow liquor would be to settle it in a separate tank, return the solids to the digester (preferably to the final stage of multi-digestion systems so as not to dilute the raw sludge with excessive mineral matter) and deliver the settled liquor to secondary treatment processes, or direct to the receiving stream after chlorination in the case of primary plants. Apparently Doman[m] followed this plan successfully at Greenwich, Conn.

Aeration of the liquor sweeps the gases out, improves the settleability of the solids and destroys whatever bacteria or enzymes present that interfere with primary sedimentation basins. Both the Pacific Flush Tank Co. and American Well Works Co. manufacture special equipment to combine aeration and sedimentation of supernatant liquor in single tanks[28], but I understand their usefulness is limited to liquors containing less than 1.5% total solids.

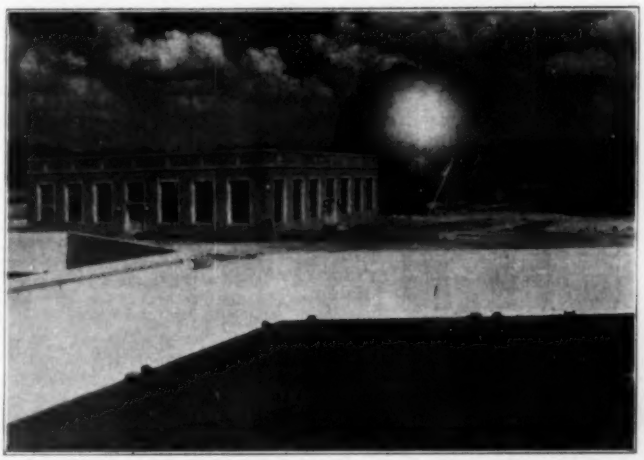
Since the raw sludge is usually most voluminous at activated sludge plants, supernatant liquor has usually been the most troublesome at those plants. Kraus[29] has developed a process that practically eliminates the problem, by eliminating the liquor. To apply his process it is essential to have a sludge re-aeration tank. Overflow liquor from the primary digester of a multi-digestion system is combined with part of the return activated sludge and aerated in this tank after which it is returned to the settled sewage entering the main aeration tanks. The procedure not only improves the performance of the activated sludge process, but eliminates the necessity of withdrawing overflow liquor from the final digestion tanks.

Poor digester overflow has frequently been disposed of in lagoons. This works until the lagoon is full. As previously stated, the desludging of a lagoon is an expensive, difficult and disagreeable job. Supernatant liquor should not be run on to sludge drying beds as it soon seals the sand and ruins the beds.

Foaming

In my opinion foaming is really nothing but very rapid and violent gasification which results in completely mixing the contents of the digester and producing a foam-like scum which boils out over the country side. It is typical of what may be expected in a grossly overloaded digestion chamber. It can best be stopped by reducing, or completely discontinuing, the introduction of raw sludge for a week or two during which time digestion has a chance to catch up with the supply of digestible material in the tank.

While it is conceivable that a digestion compartment might foam continuously due to daily applications of excessive load, that is not the common case. Usually one or the other of the various requirements for good digestion such as temperature, alkalinity or seeding has been allowed to drop so far below the optimum that digestion dropped off; the operator either failed,



Cleveland, Ohio. Hexagonal Digestion Tanks, PFT Floating Covers, Hortonsphere Gas Holder.

or was unable, to correspondingly reduce the daily applications of load so that there was a gradual accumulation of undigested organic matter in the tank. Finally, the poor condition, be it temperature, alkalinity, or seeding, is corrected. As a result, all of that accumulated organic matter starts to digest at once, gasification becomes excessive and foaming occurs. Since more carbon dioxide is produced during the early stages of digestion, i.e. digestion of carbohydrates, the CO_2 content of the gas may increase; the alkalinity of the sludge would tend to drop. Liming or ammonia applications might off-set that tendency but this would only further accelerate digestion and foaming until the overloaded condition was reduced.

Foaming is most prevalent in the spring of the year in unheated tanks. Unless the operator can reduce the loading on those tanks during the cold winter months, he cannot avoid foaming in the spring when the digestion temperature rises.

Unless adequate seeding material, i.e. digesting sludge, is used in starting up a new digester, the digestion process will be slow until the proper organisms fully develop. Unless raw sludge applications are reduced during the starting period, there may be an accumulation of undigested organic matter that, when sufficient "bugs" have developed, all digests at once with resulting foaming. The maintenance of optimum temperatures, alkalinity and mixing during the starting period will hasten the development of the desirable micro-organisms and so reduce the time required to establish normal digestion, and the danger of foaming; it may not entirely prevent foaming unless the feeding of raw sludge has been kept at a minimum. It seems quite probable that the use of ammonia gas instead of lime for controlling alkalinity during the starting up of a new tank would be particularly desirable.

Schlenz[30] describes a case in which foaming resulted from the seeding and ammonia treatment of a 9 ft. depth of scum. The fault in operation was not the seeding and ammonia treatment, but the failure or inability of the operator to prevent such an accumulation of undigested organic matter.

Some plants are so inflexible in their design that even the smartest operator cannot avoid occasional foaming. Similarly operators' ignorance cannot prevent foaming in even the best of plants. Foaming and all other troubles can best be prevented by improving both the flexibility of the plant and the knowledge of the operator. The latter objective has been the purpose of this series of articles.

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(27) T. R. Haseltine, "Digestion of Activated and Primary Sludge at Salinas, California". Ibid, vol. 4, p. 608 (Oct., 1931)

(28) C. V. Erickson, "Treatment and Disposal of Digestion Tank Supernatant Liquor", with discussion by L. H. Chamberlain and J. Doman, Ibid. vol. 17, p. 889 (Sept., 1945)

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SPEEDING UP SEWER MAINTENANCE BY THE USE OF TRAILERS

by

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THE moving of heavy equipment in the maintenance of a sewerage system will increase the cost of operations if old-fashioned methods or obsolete trailers are used. One accident caused by a trailer having no brakes or one with poorly equipped brakes, or by a trailer whipping from side to side and not following the truck properly, will cost more than would be expended if efficient, properly designed modern equipment were used.

Modern methods in handling heavy equipment such as the moving of heavy construction machinery, tractors, bulldozers, and shovels, besides the loading of heavy drums containing chemicals or ton containers of chlorine to various parts of a city become a necessity if good maintenance practices are to be followed.

Due to a tremendous growth in the City of Los Angeles, the Sewer Maintenance Division found it practical to secure a trailer designed to reduce maintenance cost for the better utilization of equipment and add it to the fleet required to maintain the sewer system. The trailer obtained was a Callahan Trailer, Model No. 1, with a low bed of 15 tons capacity, manufactured by the Callahan Engineering Co. of Los Angeles.

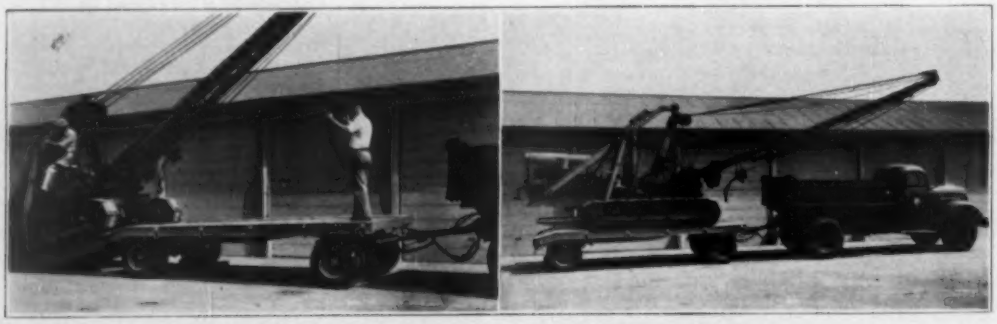
This trailer was needed for a variety of loading operations and led to the adoption of unique design as shown in the accompanying photographs. It is a drop and low-bed trailer, with short and easily handled skids. This enables the heavy equipment to be loaded with maximum dispatch, as no blocking is required. It also gives sufficient loading space for other types of loads, making the unit a universal type.

The problem of hard steering and whipping, the bugaboo of trailer operations, was met by incorporating a ball-bearing fifth wheel. The frame and body are of unit construction giving the maximum of strength and minimum of weight. The skids used in loading the trailer are 10 feet long and made from Mayari 10 in. light weight floor joists.

The specifications required of the trailer were 7:50 x 15 tires; 18,000-pound solid axles; 12 x 6 x ¾ in. mechanical brakes actuated by Westinghouse braking units; frame 5/16 x 10 in. high tensile Cor-Ten Steel.

Use of this modern trailer equipment has more than met the requirements for which it was designed. It has speeded up work operations due to the speed with which heavy construction equipment and sewer maintenance equipment could be put on the job. It has allowed equipment to be speedily transported from one location to another. It has reduced accidents and it has raised the morale of personnel because of the safe operations and the use of modern equipment in performing sewer maintenance work.

It should be a "must" in maintenance practice to do away with obsolete, costly equipment, particularly trailers with hard rubber tires, slow of movement and dangerous of operation. We, in Los Angeles, have proved that modernizing and streamlining all sewer maintenance operations reduces costs, increases production, and saves dollars for the taxpayer in the end.



Modern Callahan Low-bed Trailer

On left; loading D-4 Caterpillar Hoist with loading skis in place. On right; loaded and ready to move out with skids on trailer bed.

A NEW TYPE RESIDENTIAL SEPTIC TANK*

by

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The Author

SEWAGE from approximately one half the dwelling units in this country is disposed of by ground absorption through septic tanks or pit privies. Several important factors clearly indicate that the present use of some 600,000 septic tanks per year will probably increase rapidly in the future as the use of privies decreases.

The trend in public regulations by plumbing and health codes controlling the installation of septic tanks favors the use of rectangular shaped tanks having a liquid capacity of not less than 500 gallons. This will eliminate the use of most types of septic tanks that have been extensively used in the past except cast-in-place and pre-cast concrete units.

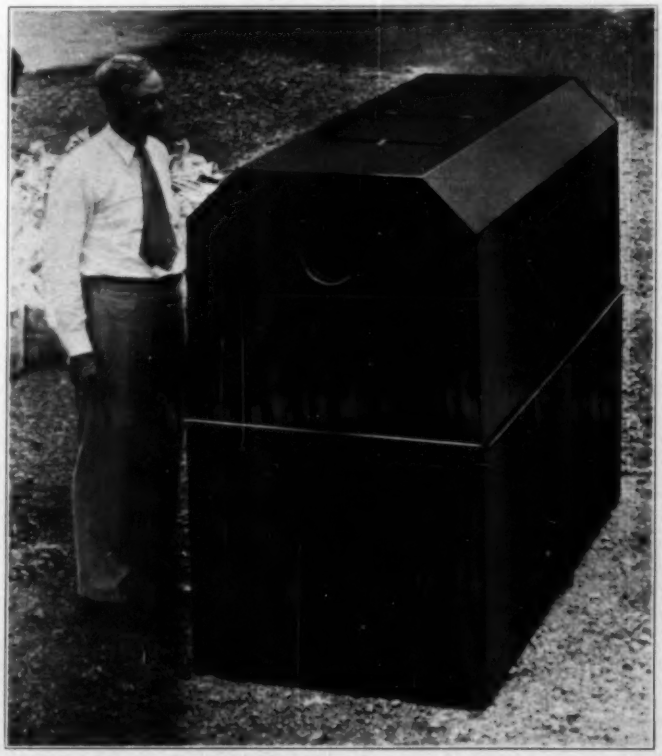
The writer and his associates have developed a rectangular shaped fabricated steel septic tank that will comply with these modern regulations, and also can be handled and economically shipped in a knocked down or nested position.

The many important advantages of the knocked down type of septic tank are (1) it can be shipped at less than one half the cost of conventional one-piece steel tanks; (2) it is the only type of prefabricated septic tank presently available that will meet modern code requirements that can be handled without special equipment; (3) ability to ship economically over relatively long distances makes mass production methods practical with resulting lowered unit costs and better quality of product; (4) knocked down septic tanks can be delivered at a cost of $45.00 to $55.00 each as compared to $70.00 to $200.00 for concrete tanks of equal capacity; (5) the knocked down feature provides the most economical and practical way to add the necessary strength and rigidity to rectangular fabricated steel tanks; (6) it can be handled by two men and is much easier and more convenient to install than other type tanks; (7) since it can be stored in jobbers' or plumbers' warehouses or on the job and can be backfilled immediately after erection, costly and irritating delays in installation can be avoided; (8) adequate corrosion protection can be provided by hot dipping each half of the tank in suitable bituminous coating material; (9) the design and the quality of the product can be controlled, thus making possible an urgently needed practice in the septic tank industry.

This paper presents a brief description of the various types of septic tanks that have been used and a detailed discussion of the design of this new type residential septic tank.

Extent of Use of Septic Tanks

Domestic sewage from residences having inside plumbing facilities is disposed of by being discharged into either public sewers or into septic tanks. Most people seem to take sewers for granted and seem to assume that septic tanks are only used in rural areas or for a few suburban homes. This is far from true, and the limited extent to which public sewers are available to residential properties is quite surprising to anyone who has not studied this problem. It has been



All Steel Two Piece Septic Tank Erected
(Details in Fig. 3)

*A paper presented before the Alabama Section, Am. Soc. Civil Engrs., and released for publication in *Water & Sewage Works*.
**Polk, Powell and Hendon, Engrs.

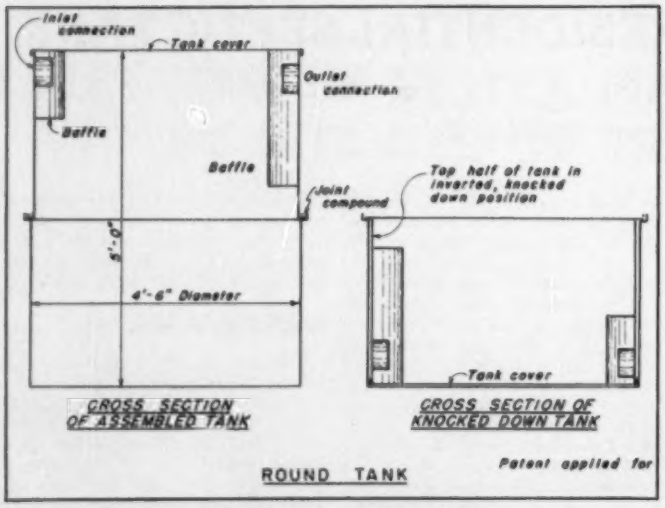


Fig. 1—Cross Section of Round All Steel Tank

estimated that approximately 600,000 residential septic tanks will be installed in 1949.

Types of Septic Tanks

The many types of septic tanks that have been used in the past are as follows: (1) Cast-in-place concrete tanks of various sizes and shapes have probably been used more than any other type. (2) Recently, thin wall precast concrete tanks have been developed. However, their use is limited, as this type of tank requires specially equipped trucks for transporting and placing each unit in operating position. (3) Cylindrical fabricated steel tanks of various sizes have also been extensively used, as they are usually the cheapest tank available and the easiest units to handle and install. (4) Two or more joints of sewer pipe joined together horizontally or connected in series in a vertical position have been used in large numbers. (5) Built-in-place brick or concrete block tanks are used occasionally; however, present skilled labor costs make these types relatively expensive. (6) Oil drums, barrels, wooden structures, and many other cheap substitutes are sometimes tried where adequate technical advice is not available.

A large percentage of these tanks was installed without any true conception of the functions of a septic tank. Many of them were too small, inadequately designed, of inferior materials or improperly installed. Structural failures and unsatisfactory operation were common. For example, concrete tankes were too small or improperly constructed, steel tanks were too small and made of extremely light gauge metal not adequately coated for corrosion protection. Concrete block tanks were not watertight, while the sewer pipe tanks were nowhere near adequate in capacity. Thin wall precast concrete tanks fail structurally when even bearing on the foundation is not provided.

Public Regulations

As a result of the extensive failures and unsatisfactory operation of many types of tanks commonly used, many of the various state, county and city health departments and other building and plumbing code authorities have in recent years adopted modern and more stringent regulations to control the installation of residential septic tanks. Also the F.H.A., which controls a large part of the present housing development, has adopted regulations that are basically uniform for

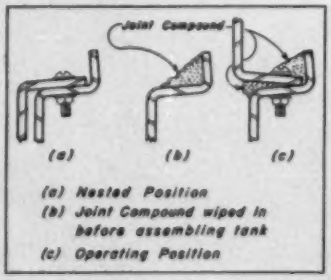


Fig. 2—Joint Details

various states but with minor variations to comply with local or state requirements. These F.H.A. regulations are representative of modern specifications and their principal minimum requirements for some ten states that were reviewed in preparing this paper are summarized below:

(1) Liquid capacity 500 gallons. (This eliminates the smaller concrete, steel and sewer pipe tanks.)
(2) Water depth from 3 to 4 feet. (This eliminates sewer pipe tanks.)
(3) Length shall be not less than 2 nor more than 3 times the width. (This eliminates the cylindrical steel and other round or oval shaped tanks.)
(4) Tanks shall be watertight.
(5) Tanks shall be constructed of durable materials not subject to excessive corrosion or decay.

Details of the various regulations vary widely and in some cases conflict with each other. However, all of them follow a general pattern of requiring inlet and outlet baffles, access manholes, etc.

These regulations eliminate all of the commonly used types of septic tanks except cast-in-place or precast concrete units. Enforcement of the regulations is spotty and irregular in various areas. In some cases the regulations are vigorously enforced by health departments or plumbing inspectors, while in other areas they are considered as recommendations only and little if any enforcement is attempted. Therefore, many of the various types of tanks described above are still used to some extent. However, there seems to be a definite trend toward more effective inspection and enforcement, and it is probably only a matter of time until practically all residential septic tanks used in this country will comply with regulations similar to those outlined above.

Knocked Down Tanks

Recently, the writer and his associates became interested in the design of a fabricated steel septic tank that could be more easily and economically handled during shipping and storage. An examination of the Interstate Commerce Commission Consolidated Freight Classification revealed the fact that the freight rate on conventional fabricated steel cylindrical tanks is Class One, while the rate on knocked down or K.D. fabricated steel tanks is Class Six. The freight cost under the Class Six rate is only approximately 40 per cent of that under the Class One rate. In this freight classification a knocked down

article is defined as one that is taken apart in such manner as to materially reduce the space occupied. This requirement can be met with a circular steel tank by making the tank in two or more cylindrical sections that will nest or knock down one section within the other. This requires some type of simple horizontal or circumferential joint in the tank.

After considerable study and experimentation the design shown in Fig. 1 was developed for a round tank. The top half of the tank is made to a slightly smaller diameter than the bottom half of the tank so that the top half can be inverted and nested into the bottom half. The simple flanged joint between the two halves of the tank is held in either the operating or knocked down position for shipping and handling by four or six small bolts. These bolts are not intended to provide a watertight joint, but are for holding the two sections of the tank together in proper position. After the tank is erected in the field the joint between the two halves of the tank is poured or wiped with suitable bituminous material to provide a watertight connection. This joint may be of the same material that is extensively used in jointing sewer pipe or pressure pipe for water mains. Inlet and outlet connections are made flush with the outside of the tank so as not to interfere with the nesting of sections. Inlet and outlet baffles are typical and can be made to meet the various code requirements and are spot welded into the top half of the tank. Compartmentalizing or sectionalizing baffles across the tank, as required in some states, can be provided by welding the top half of the baffle in place in the top half of the tank and fastening the bottom half of the baffle to the bottom of the tank with a metal hinge or metal clips. When the tank is knocked down the bottom half of the baffle is resting horizontally on the tank bottom. When the tank is erected the bottom half of the baffle is raised to a vertical position to meet the top half of the baffle and is held in this position by simple metal clips spot welded to the tank walls.

For a rectangular fabricated steel tank that would meet the modern code requirements for residential septic tanks, the design shown in Fig. 3 was developed. The round and rectangular tanks are similar except the shape of the tanks and the type of tank covers. The cover of the round tank is removable and is held in place by simple metal clips spot welded to the tank. The cover of the rectangular tank is an integral part of the tank and access is provided by a small manhole whose cover is also held in place by metal clips spot welded to the top of the tank. To provide 500 gallons liquid capacity and to meet code requirements regarding width to length ratio, the minimum size rectangular tank would be approximately 5 ft. deep by 6 ft. long by slightly less than 3 ft. wide.

Various types of bituminous compounds have been tried for either pouring or wiping the horizontal joint between the two halves of the tank. Two types of pipe joint compound which must be heated and poured into the joint after the tank is erected gave satisfactory results. Three grades of roofing cement that were wiped or spread in the joint without heating also proved satisfactory. The asphaltic roofing cement is preferred because of the ease and simplicity of making this type joint. The cement is wiped into the flange on the bottom half of the tank in a triangular shape that fills the space between the shoulder and the top of the vertical flange. The top half of the tank is then set into position on the bottom half which compresses the cement between the two flanges of the joint where this compound adheres to or melts into the coating on the tank. The shape of the joint leaves a wedge shaped ring of cement on the pressure side of the joint which provides a connection that

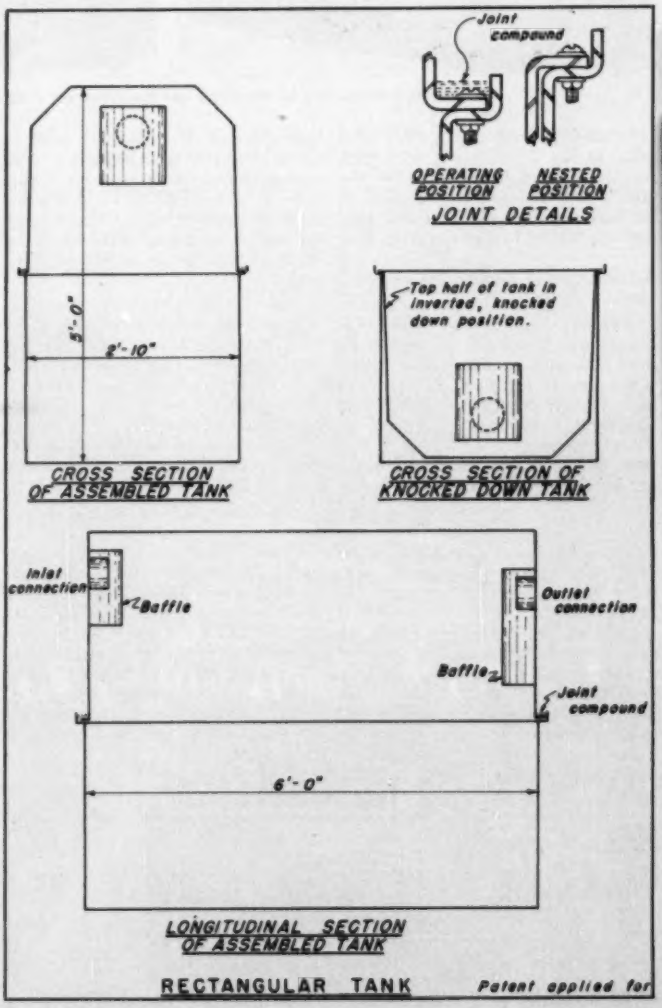


Fig. 3—Sections Through Rectangular All-Steel Tank
(Note that top section is tapered to nest into lower section for shipping, storing, handling)

Nesting and Handling the Nested Top and Bottom Sections of the Tank by Two Men

is permanently watertight. (See joint detail in Fig. 2.) Either type of joint may be formed before or after the tank is lowered into the excavation, as the bolts through the joint will support the bottom half of the tank.

Advantages of Knocked Down Tanks

Although the knocked down tank design was developed principally to save shipping and handling costs, when some of these rectangular tanks were actually constructed many other important advantages over conventional construction were found. The more important of these advantages are briefly presented in the following discussion.

(1) The knocked down tank can be shipped for less than one half the cost of shipping conventional one-piece tanks. The freight rate per 100 pounds, the freight cost per tank, and the savings in freight cost per tank for one knocked down rectangular 500 gallon septic tank as compared to a conventional one-piece tank of the same weight shipped for various distances is shown in Table I.

(2) Costs of fabricating round knocked down tanks are comparable to conventional one-piece cylindrical units. In fabricating the cylindrical knocked down septic tanks two more manufacturing operations are required than for a conventional one-piece tank. First, the sheet forming the sides or walls of the tank must be passed through the bending rolls twice or in two pieces. However, the expense of this bending operation is offset by the fact that narrower sheets may be used. Prime steel sheets are sold at a base price for sheets up to 36 inches wide. Sheets wider than 36 inches carry a width extra cost that varies with the size of the sheet. The extra cost of a sheet 48 to 60 inches wide is $0.45 per 100 pounds. The narrower sheets required for knocked down tanks represent a saving of $0.45 per 100 pounds of metal in the wall of the tanks, which would more than offset the extra cost of rolling. Second, the joint on the bottom half of the tank must be passed through a small forming roll and the bolt holes in the joint punched or drilled. These operations require only a few minutes and the extra cost is only a small fraction of one man-hour. The amount of welding is comparable in both types of tank. The only extra materials required are the few additional pounds of metal in the flanged joint and the joint compound supplied with the tank to pour or wipe into the joint when the tank is installed. The amount of metal is insignificant and the three to four pounds of joint material required cost only about three cents per pound. If the hinged baffle is required it can be installed as cheaply as a fixed baffle in a conventional tank.

Table I

SAVINGS IN FREIGHT COSTS

Distance Shipped Miles	Conventional Tank Freight Rate/100#	Conventional Tank Freight Cost	Knocked Down Tank Freight Rate/100#	Knocked Down Tank Freight Cost	Savings in Freight Cost
100	$1.09	$5.45	$0.43	$2.15	$3.30
200	1.55	7.75	0.61	3.05	4.70
300	1.85	9.25	0.75	3.75	5.50
400	2.15	10.75	0.86	4.30	6.45
500	2.39	11.95	0.95	4.75	7.20
600	2.60	13.00	1.04	5.20	7.80

(Based on shipping weight of 500 pounds)

These data show that the knocked down tank can be shipped for a distance of 600 miles for slightly less than the cost of shipping a conventional one-piece tank 100 miles. The savings in freight cost per tank of this size varies from $3.30 for 100 miles to $7.80 for 600 miles. The savings on smaller or larger tanks would be in proportion to the weight of these tanks.

The above data are based upon current railroad freight rates. For shipping by truck equally large savings can be realized. Forty-five of the 500 gal. capacity rectangular knocked down tanks can be loaded on a transport truck. One tank manufacturer estimates that he can ship these 500 gal. knocked down tanks 250 miles by his own trucks for $3.00 per tank.

(3) Manufacturing costs of rectangular knocked down tanks are apparently considerably less than the cost of one-piece rectangular tanks that will meet modern code requirements. The rectangular knocked down tank is fabricated by forming the two halves of the tank separately and welding the ends of the tank to them. Except for installing the conventional inlet and outlet connections, baffles and the access manhole, only three basic operations and three pieces

of shop equipment are required. The plates are sheared to size with considerably less waste metal than is necessary in making a round tank of similar capacity. Then the two halves of the tank and the joint are formed on a power brake with only two dies required. The sheets are passed through the power brake lengthwise so that the width of the sheets forms the length of the tank. This provides an integral top and bottom to the tank and eliminates all welding in forming the body of the tank except the welding required in installing the ends of the tank. However, two sheets 36 inches wide may be flat welded before forming more economically than 72-inch wide sheets can be purchased when the width extra cost of $0.55 per 100 pounds for 72-inch wide sheets is considered. Since no separate cover is necessary the forming of the cover flange is eliminated. The knocked down tanks can be completely fabricated including the installation of connections, baffles and manhole in two sections or halves. This reduces the weight to be handled to where two men can easily handle the tank without the use of power equipment, which would be much slower in some operations. Connections and other details are similar to the round tank.

(4) Knocked down tanks can be mass produced with resulting savings in manufacturing costs. Conventional steel septic tanks have been manufactured by more than 400 steel fabricators in this country; yet in 1939 less than 10,000 net tons of steel, which would represent less than 50,000 tanks, were used for this purpose. It is, therefore, obvious that few of these manufacturers made more than very small numbers of tanks. This was because the tanks are difficult and expensive to ship and the quality of the product was not up to code requirements in many areas. The larger fabricators in the Birmingham area make these septic tanks in units of 10 tanks which are sold before any more are made. With knocked down tanks which can be economically shipped several hundred miles, manufacturers can reach sufficient markets to justify installing modern production line equipment and methods to mass produce tanks of superior quality that will meet all code requirements. This will result in lower manufacturing costs in the fabricating shop and in overhead charges. The storage space required to coordinate production with delivery is reduced by more than 50 per cent when the knocked down tank is used.

(5) The knocked down design is the most economical method of providing the necessary strength and rigidity in a rectangular steel tank. A conventional one-piece rectangular tank 3 feet wide by 5 feet high by 6 feet long made of 12 or 14 gauge steel sheets would not be strong enough to support the loads from backfill on the sides, water inside or backfill on the top of the tank, without extensive structural framing. When this type of tank is filled with water the sides and ends bow out until the shape of the tank approximates an oval. Also the top of the tank would sag badly under backfill loads. The knocked down tank has the strength and rigidity necessary because of (1) the integral bottom; (2) the integral top; (3) the diagonal shape of the top corners which reduces the unsupported span at both the sides and the top; and (4) beam action of the joint around the center of the tank. This knocked down feature appears to be the most practical and economical way to fabricate a welded steel rectangular tank. Since most codes require a rectangular shape of this size, this design or something similar is necessary where steel tanks are to be used. With a one-piece rectangular steel tank structural angles welded to the sides and top to provide strength and rigidity could be used but would be much more expensive than the knocked down tank, and this tank would not be practical to ship any appreciable distance.

(6) Knocked down fabricated steel tanks are the most economical type of acceptable rectangular septic tanks available. Cast-in-place concrete tanks that will meet most code requirements require about two cubic yards of reinforced concrete. Under present conditions this type of tank will cost from $100 to $200. Precast concrete tanks which are available only in certain areas are selling at from $70 to $80 each. The knocked down coated steel tank can be delivered at from

Demonstrating Ruggedness of the Assembled Tank

$45 to $55 per tank. When extensive efforts are being made throughout the country to reduce the existing high cost of housing facilities, these savings in sewage disposal are significant.

(7) The knocked down steel tank is the simplest and most economical unit to install and is the only tank large enough to meet most code requirements that is practical to handle and store. Precast concrete tanks are available only in limited areas and must be delivered and installed by special truck cranes. Knocked down tanks can be handled during shipment by two men, and can be installed by a plumber and his helper. (See pictures.) They can also be stored by jobbers or stored on the job so that there is less chance of delay waiting for delivery. Storage space is reduced by at least 50 per cent. No serious difficulty or delay is encountered in installing in locations not accessible to truck cranes to deliver precast concrete tanks or to trucks delivering concrete or concrete materials or waiting for cast-in-place concrete to set and harden and forms to be removed. The use of cast-in-place concrete tanks requires purchasing and delivering cement, sand, coarse aggregate, form lumber, nails and reinforcing steel. These deliveries must be coordinated with the construction of the tanks and loose materials are often wasted or stolen. Fabricated tanks require only one purchase and one payment, coordination is simplified and all wastage of materials is eliminated. Cast-in-place construction requires the proper mixing of the concrete materials, installing the form work, erecting reinforcing steel, placing the concrete, waiting for the concrete to set and removing the forms. Cast-in-place concrete covers make removing the form very difficult, while separately cast covers are difficult to handle. Baffles, connections, and access manholes require difficult and expensive form work or expensive castings. Knocked down fabricated tanks can be installed by two men in a few minutes which eliminates these difficulties and delays and the attendant hazards from bad weather. In rural areas where many tanks are installed by the property owner, who is usually unskilled in concrete work, the advantages of a fabricated tank are even greater. Also the inspection of fabricated tanks by code authorities is greatly simplified, as only the joint and coating need be carefully checked. It is therefore apparent that the knocked down tank offers many economies, conveniences, and other advantages in handling and installing.

(8) Knocked down steel tanks can be protected from corrosion to provide a life comparable to other building materials. It is commonly assumed that the sewage and accumulated sludge in a septic tank are extremely corrosive. Actually, the corrosion conditions are not unusual except inside the tank above the water line where corrosive action can vary from mild to extremely severe.

Corrosion on the outside of the tank depends upon the type of soil in which it is installed. The corrosive action of soils varies widely in different locations. To meet these conditions steel tanks, like any other underground metal structure, should be protected by proper coating just as pipe lines, culverts and other engineering works are protected.

The septic action in a tank of this type is anaerobic, which means in the absence of oxygen. Since the absence of oxygen inhibits or prevents extensive corrosion no particular problem exists inside the tank below the water line. In addition, the inside of the tank below the water line is quickly coated with grease which acts as a protective covering where kitchen wastes pass through the tank. Digestion of the organic solids gives off a gas which contains sulphur compounds that are highly corrosive in the presence of air or oxygen. Engineering literature cites many examples of the failure of steel or thin concrete sections from exposure to these gases in other types of structures such as sewer lines, treatment plants, etc. These failures are above the water line where air or oxygen is present. The inside of the tank is connected to the toilet vents through the plumbing system so that digestion gases can escape. The flow of these gases is upward and where a tank has a tight cover little air or oxygen can enter the tank, and anaerobic conditions which inhibit corrosion probably exist above the water line in most properly constructed tanks.

However, good engineering practice requires that underground steel structures be protected from corrosion on both the inside and outside surfaces. This is usually accomplished by coating the steel with a suitable bitumnnous coating material. These coatings, such as the well-known "Bitumastic" compounds, when properly applied, have a proven history of protecting steel structures for as long as the life of the average dwelling. They are commonly used on important installations such as cross-country gas lines, water supply lines, steel water tanks, sewer pressure mains, sewage treatment plants, underground tanks, etc. They are also extensively used to protect ships and other metal structures from salt water corrosion which is one of the most severe conditions known.

To be most effective and economical bituminous coatings are applied by hot dipping. The two-piece knocked down tank is especially adapted for hot dipping, as each half is easily submerged in a suitable heated vat of molten coating compound, and the open construction provides ready drainage of excess coating material as the half tank is removed from the dipping vat. This process can be used to apply a bituminous coating having a thickness of approximately three-thirty-seconds of an inch over all areas of the steel tank. This will provide one of the most permanent and economical types of underground tanks known. Should the coating be scratched or otherwise damaged during shipment it can be readily repaired by being "touched up" with the bituminous joint compound or by other material furnished for this purpose as the tank is installed. With the knocked down design only one half of the outside of the tank is exposed during handling and shipping. Excessive damage to the coating on the outside of the bottom of the tank can be avoided by spot welding scrap metal supports to the tank bottom. When the top half of the tank is dipped in heavy coating compound the access manhole cover is sealed in place, and except for inlet and outlet connections the erected tank is vacuum tight.

(9) The knocked down tank design can be used to control the quality of tanks manufactured. A patent application has been made for the knocked down septic tank and the patent rights are owned by Knocked Down Tanks, Inc. The writer is president of this company. In order to realize the advantage of the knocked down feature in shipping these tanks, manufacturers will be licensed to make this type of tank in only five or six selected locations in the country. By carefully selecting manufacturers interested in making a quality product, many of the evils of the round tank industry which has been described as a "dog-eat-dog" industry can be corrected as the use of conventional small, round septic tanks is eliminated by code requirements. Steel manufacturing and leading tank fabricating companies and large users of septic tanks throughout the country have shown considerable interest in the use of this type tank so that selecting reputable manufacturers should not be difficult.

OPERATING THE WATER DISTRIBUTION SYSTEM*

by

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I WOULD like to discuss the part of the water works system that is out of sight—and, much too often, out of mind. I'd like to talk about *operating* the distribution system, not just its maintenance.

I note that at meetings of water works men very little of the program is devoted to the distribution system. Is that because our distribution system problems have generally been solved?—or, that nothing new is developing? Not by any means. My hazard is that it is difficult to get speakers unless the speakers have the answers. And, there are lots of distribution system problems unanswered.

How Important Is the Distribution System?

How important is the distribution system? The purification man frequently finds the distribution system one of his biggest headaches. The water leaves the plant in perfect shape—well, maybe with a little taste and odor—and nobody should complain of the faint, very faint chlorine taste,—it's good for you. But when the water comes out of the customer's tap that's another story. It is red, or black, or white, and fishy. Not always, but too often. This unfortunate circumstance is termed "deterioration of water quality." The purification fraternity has written many papers on what happens to "good" water when it gets into "bad" company.

How many dollars have we buried when we have laid our mains? In 1943 L. R. Howson, a past president of this Association, estimated the value of the distribution system in the average city to be about $40 per capita, with pipe and valves representing about 80% of the distribution system value. In the last six years the values of water mains have risen greatly; they should now approximate $50 per capita, or more. I'm not talking about cost, that was much lower.

My son, the other day, asked me a few questions involving practical applications of physics and mathematics.

The Author
(Pres.-Elect A.W.W.A.)

I came through with flying colors—the right answers. Then he asked me "Why could George Washington throw a silver dollar across the Potomac, when nobody is able to do it today." Frankly, I couldn't answer that one. My boy then said that it wasn't too hard to answer, because everybody knows that "a dollar would go much further in those days." So it is in the water supply field. Fifteen years ago we could buy 6" cast iron pipe for 40c a foot. Wouldn't you like to have a yard full today at that price?

When we think of the value of the distribution system that water works superintendents and managers are entrusted with, we should think in terms of present day dollars. On an average the superintendent in a city of 10,000 is responsible for a pipe system which couldn't be duplicated for a half million dollars. If the population is 25,000 he has a buried plant with a million and a quarter dollar value. 5 million dollars is the average value in a city of 100,000; 10 million dollars in a city of 200,000.

My thought is that the quarter million dollar water transportation system in the city of 5,000 and the fifteen million dollar system in the city of 300,000 should be operated as economically and efficiently as any other industry transportation or utility system of similar value. All too frequently this is not the case.

A couple of years ago I was in an observation car on a train running from Kansas City to St. Louis. The division engineer and a couple of aides were making one of their routine inspections of the track and right-of-way. I was impressed by the detailed knowledge the engineer had of everything along the 280 miles of track. He knew every culvert, siding, cattle chute, animal pen, rail replacement and wiggle in the track. Of course, his job was easy,—he could look at or feel what he was responsible for.

Your jobs have to be done differently. We may claim to have photographic memories, and can go out in the dark and put a foot down on any valve box in the system. Or we say that good old "So and So," who has been connected with the system since the year one, can do it. Aren't we kidding ourselves?

Value of Arterial Maps

Others keep account of the pipe and valves in the system just as carefully as they account for the dollars spent. I like to walk into a superintendent's or manager's office and see a map of the arterial mains on the wall. I know he is keeping constantly before him the number one problem: How can the necessary quantities of water be transported from the plant to the various parts of the system in the most economical manner? He can't ride around and visually inspect his system as the railroader could. I know of no other way than to show, and record, his system in the several types of plat and measurement records he needs in the daily operation of his system.

One of the most valuable operating "tools" is an arterial map; a plat showing only the arteries of the main system. The principal mains should be shown by lines with widths at least proportional to the pipe diameters, or preferably proportioned according to the square of the diameters, thus showing the comparative carrying capacities of the principal mains. No small mains or hydrants should be shown. No street lines should be shown. A minimum of street names should appear; the person using this map should know his way around without requiring street signs on this map.

This map will be a simple, uncluttered picture. It will show where the mains are undersized. It will also show the mains which are doing little work. It will show the manager where he can expect trouble when an area

*This paper, based on a talk made by Mr. Weir, as Vice-Pres. of the Am. Water Works Assn. before the Southwest Section, is here printed by permission.

builds up, or when those record hot dry spells strike.

What is the operating procedure when a pipe in the system breaks? Men may be rushed to the scene to stop the damaging flow of water. In an enterprising system radio may be used to speed the job; but, when the men get there, do they know where the valves are? This is a particularly serious question at night, or during a storm, or if snow is on the ground.

Truck Maps

Each crew foreman should carry in his truck a map showing all distribution mains and a record of location measurements for every valve he might be called upon to operate. You may say that isn't practical for a large system. My suggestion would be that you investigate the "plat and list" method of keeping these main and valve records. The system is simple. Any required number of copies can be easily produced. The record is far from bulky, even though the system may contain ten or twenty thousand valves. You will find the system described in the February 1940 A.W.W.A. Journal. Reprints can be obtained from the A.W.W.A. Headquarters, and sample sheets may be had from the St. Louis County Water Co., for the asking.

I regret there is not time to adequately discuss another important operating tool—radio, except to say that every up to date water utility is finding radio an indispensable operating adjunct.

A distribution system normally grows like "Topsy." It starts with a system laid out by a consulting engineer. Then more customers and mains are added without following any master plan. A couple of hot summers occur, with deficient pressures, and a consultant is called in again to correct the ravages of time. A large part of distribution system extension should really be considered as a matter of ordinary operation.

Materials Used in the System

Efficient operation calls for the use of economical, long lived materials. We tend to be conservative, perhaps too conservative, in our industry. I think conservation is a good thing, but I'm afraid lethargy often parades as "conservatism." As an example, some men still design cast iron pipe installations using a Williams-Hazen C=100 in evaluating the delivery capacity of mains. This is because tuberculation, they say, will reduce the coefficient to that amount in a few years. A too slim segment of water works men today consider this to be an antiquated practice, because they no longer buy anticipated tuberculation with their pipe. Cement linings or non-ferrous pipe is the answer, and both have been available for several years now. Yet, today, nearly half of the cast iron pipe being purchased has the old tar dip coating. It is just that—a "coating"; it shouldn't be dignified by calling it a "lining." Thin cement linings protected by a seal coat to prevent leaching can now be purchased at the tar dip price. Thicker cement linings, suitable for the most aggressive waters, can be purchased for a few cents a foot additional. Why let your system get hardening of the arteries when the remedy is so reasonably priced?

Cement lined or concrete pipe and cement-asbestos pipe will not tuberculate. Steel pipe can also be lined to present a smooth non-tuberculating surface to the water. Depending upon the conditions under which the main is to be laid we have several suitable materials to choose from—without a tubercule in a carload.

What should we do about those old tuberculated mains? Why, clean them—it isn't costly. Keeping them smooth inside is a more difficult problem, but two methods are available for lining large mains in place, and two methods are also available for lining small mains in place.

Know the Condition of Your Mains

To be good operators we must know the condition of our individual systems. Whenever we get a chance to take a look at the inside of our mains we should do so. Maybe we can find out what causes the deterioration of water quality after the nicely prepared product leaves the purification plant. Maybe we can find what materials in the system are not functioning as they should, so we can purchase better, more suitable, materials in the future.

A searching attitude will pay big dividends to the water utility which is paying for the installation, maintenance and depreciation on billions of dollars of underground piping.

What is happening in your system where dissimilar metals are in contact? No chemical engineer or metallurgist would advise the indiscriminate use of brass and copper in contact with iron and steel. Have you ever noticed the accumulated products of corrosion where a brass meter coupling is screwed into a steel fitting? Or that a steel nipple will soon perforate alongside a brass valve, or where it is connected to copper pipe? Is galvanic corrosion occuring in your valves, or in the bottom of your fire hydrants, where brass or bronze, iron and steel are in close contact?

Is the jointing material in the mains holding up as well as the pipe itself? Is the jointing material as strong as it was when it was installed? Has there been any chemical or corrosive reaction between the material of the pipe and the material of the joint? Have you ever sandblasted the bell and spigot metal of an old joint to see whether graphitic corrosion was evident, or that the pipe metal was otherwise injured?

There is no perfect material offered our industry. Each material has its shortcomings, and we should know what they are. Our mistakes are made by installing materials not suitable to the environment in which they are placed, or not suitable to the water quality and pressure conditions, or by installing the materials in a faulty manner. A good operator learns by his mistakes, and by the mistakes his neighbor makes.

Let's keep a critical eye upon our own practices. Let's keep a critical eye upon the materials being offered us even though they may have received general acceptance by our industry. They have all been improved in the past and can, without doubt, be improved in the future. We have all experienced or known of instances of too early failure of various distribution system materials. Are the failures due to unusual water or soil conditions we have not previously recognized? Or can we say to the manufacturer—your material is not suitable,—and give him a definite reason? He can then improve it, or we can go to a different manufacturer or a different material.

Pass on Your Experiences

For the collective benefit of system operators they need to know of good experiences with new materials which are being offered the industry. They also need to know of failures, and what caused them. We should hear about these good and bad experiences in short schools and sectional meetings such as this. These experiences should also be offered for publication in the magazines serving our field. The various committees of A.W.W.A., charged with drawing up standard practice procedures and specifications for accepted materials, should receive such information. Their work is of great value in the selection of good distribution system materials.

Let each of us be constructively critical of everything pertaining to the distribution system, our maps and records, our construction and maintenance practices, the materials in our systems, and the materials being offered for our use.

FUNDAMENTALS OF CORROSION AND ITS MITIGATION*

Part I—Definitions. Part II—Fundamental Reactions

by

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N.E.W.W.A. COMMITTEE ON CORROSION

THE Committee to Report on Developments in our Knowledge of Corrosion and its Mitigation was established by the N.E. W.W.A. in 1942. The pressure of war activities on the membership of the Committee prevented any effective work during the subsequent years until July, 1948, when a meeting was held to determine its future course.

Further discussion led to the conclusion that the Committee might partially fulfill both objectives by adopting the following courses of action:

1. To prepare a basic report which would, insofar as possible, summarize present knowledge on corrosion.

2. Using this basic report as a point of departure, to examine critically the new developments in the field at such times as the Committee considers that sufficient evidence is at hand for examination and reporting.

The present report is submitted as the basic report of the Committee.

I. DEFINITION OF CORROSION

A. Manifestation

In order to carry on adequate studies of corrosion in the field of water supply, it is necessary that criteria be established that may be used to determine the existence and the extent of the problem. Since corrosion has to do with piping systems and water supplies, its existence is recognized by its effects on either or both. In general, the effects of corrosion on the water supply are manifested much sooner than the effects on the piping system. This report will deal primarily with the corrosion of the interior surfaces of piping and will not be concerned, except indirectly, with corrosion of the exterior surfaces due to contact with various types of soils or to other agencies.

1. **Effect on System—Destruction, Tuberculation, Clogging.** Corrosion consists primarily of the solution of the metal components of the piping system by the action of the various substances present in water. The continuous solvent action results in a weakening of the pipe structure, which eventually may manifest itself in many ways, such as

a. Leaks in service lines, mains, domestic piping
b. Leaks in domestic hot water boilers
c. Corrosion of water meter parts

Inspection of any piping that has developed a leak will reveal the solvent effect of corrosive action in the form of pitting, dezincification, or general reduction in pipe thickness.

Another evidence of corrosion is the occurrence of tuberculation in the piping. When certain metals, especially iron, go into solution in water, they tend to react with the basic substances and the dissolved oxygen in the water and form insoluble compounds. These compounds tend to form and adhere to the pipe in the immediate vicinity of the point where the corrosion is taking place. This precipitate adheres to the pipe and accumulates in the form of tubercles. The effect of such tuberculation is to reduce the carrying capacity by a decrease in the effective diameter of the pipe and by an increase in the frictional resistance to flow. Where tuberculation is excessive, marked reduction of flow and pressure will occur, and reduction in flow and pressure in sections of a water supply system may be taken as evidence of marked corrosion of the piping system.

2. **Effect on Water.** When corrosion of piping occurs, the metal goes into solution in the water in the form of charged atoms, which are called ions, and therefore the presence of these corrosion products in the water is evidence of the existence of corrosion.

a. *Soluble and Insoluble Metallic Compounds*

The presence of some metal ions in water may be evidenced by visible effects such as the presence of sediment, by an increase in the turbidity of the water, by a change in the color, or by the imparting of a visible coloration to an otherwise satisfactory, colorless water.

b. *Turbidity, Color*

Where iron pipe undergoes corrosion, iron hydroxide is formed, which is usually manifested in the familiar form of brown iron rust, somewhat fluffy in appearance. Occasionally during a heavy draft on the pipe or a change in the direction of flow, a certain amount of the tuberculation of iron hydroxide will be loosened from the main and appear in the tap water as a brownish sediment. Small quantities of iron in solution in a water will impart a turbidity or a yellowish color to the water because of the presence of iron in colloidal form. The presence of high concentrations of copper in solution will impart a bluish cast to the water. Such concentrations are rather unusual in water supplies, but the addition of soap to the water or the presence of a large volume of water, as in a bathtub, will tend to bring out the bluish color. The presence of zinc or lead rarely imparts either color or turbidity to a water.

c. *Taste*

High concentrations of metallic ions will impart a characteristic unpleasant metallic taste to the water. For instance, iron in solution imparts a sharp metallic taste in concentrations of approximately 0.5 to 2.0 ppm.; copper is similarly perceptible in concentrations of about 5 to 10 ppm., and zinc in concentrations of about 20 ppm.

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*Report of the Committee of Developments in Our Knowledge of Corrosion and Its Mitigation presented at the N.E.W.W.A. Annual Meeting in 1949. Published here by permission of the Association.

1) Assoc. Prof. of San. Engr., Harvard Univ. and Chairman of the Committee.

2) Mech. Engr., Metr. Dist. Water Supply Comm., Boston, Mass.

3) Chief of Laboratories, Water and Sewage Laboratories, Mass. State Dept. of Health, Boston, Mass.

d. *Toxicity*

The presence of metallic ions in water may sometimes affect the health of the consumer. Of the various metals commonly found in water supplies, lead is the most harmful. Concentrations in excess of 0.1 ppm. are considered unsafe for potable supplies. Although there is little or no evidence of damage to health from the presence of either copper or zinc in concentrations such as occur in water supplies, it has been found desirable to limit the concentration of copper to a maximum of 3.0 ppm. and of zinc to 15 ppm. in potable waters. There is no evidence of any physiological effect produced by excessive amounts of iron in solution, but its presence is objectionable for various domestic purposes in concentrations of over 0.3 ppm.

B. Quantitative Estimation of Corrosion

1. **Methods Available for Measuring Corrosion.** Measurement of the extent of corrosion consists in determining either the extent of its action on the metallic piping, its effects on the water stored in the pipes, or both.

Quantitative measurement of the extent of corrosion of the piping system may be based on any of the following methods:

a. Loss of weight of the metal
b. Depth of pitting of the metal in a given time interval
c. Change in the friction coefficient of the pipe
d. Frequency of required meter overhaul and of incidence of failure of domestic plumbing fixtures such as hot water boilers

The first two methods are of value in the determination of the relative corrodibility of various metals and as a guide in the choice of the best metal for a given purpose. The extent of the penetration of a metal due to corrosive action in a given interval of time may be used in gaging the probable useful life of the metal, and comparison of these effects on two or more metals under the same conditions of corrosion may be used to estimate the relative merit of such metals. These methods are of relatively little use in the waterworks field, first, because most corrosion problems are concerned with old piping systems, and, second, because where the choice of new piping is involved the time required to carry out such measurements is usually not available. Once a piping system is installed there is rarely an opportunity to remove sections for study of corrosion effects.

In this connection it may be stated that the so-called "jar test"*—in which a small section of pipe is allowed to stand in contact with a fixed quantity of water for a certain interval of time and the results observed, usually visually—is not a satisfactory method for predicting the results that will be obtained in actual use. The rapid change in the corrosive properties of the water and the unusual initial corrosion effects on the metal make the jar test of little value.

The tuberculation caused by corrosive action offers a satisfactory means for the quantitative determination of the extent of corrosive action. The effect of tuberculation is of course to increase the friction loss through the pipe and to reduce the effective diameter of the piping. Where it is known that the tuberculation is caused primarily by corrosion, measurements for the determination of the value of "C" in the Williams and Hazen formula offer a fair criterion of the condition in the mains. However, it must be noted that some forms of pipe incrustation are not related to corrosion.

Where means for such measurements are not available, a more qualitative and less satisfactory method is to look for corrosion and clogging of the meter parts and to note the interval between the required cleanings of meters. Too frequent clogging of meter gears indicates excessive corrosion. Similarly, unusually short life of domestic plumbing systems such as hot water boilers and house piping offers a rough indication of the extent of the corrosive effects of the water.

The change in the quality of the water between the source and the consumer's tap after passage through the various service lines offers an indirect measure of the extent of corrosion of the various kinds of metallic piping in the system. An increase in the content of iron, copper, zinc, or lead indicates corrosive action, and its intensity can be estimated by considering the increase in metal concentration with respect to the time of contact between water and pipe.

The dissolved oxygen content of the water can be used as a measure of the extent of corrosion of iron piping. Since oxygen is a primary agent in promoting corrosion and since it is used up in proportion to the amount of iron being dissolved, the drop in the dissolved oxygen content between any two points in a piping system is a measure of the extent of the corrosive action taking place there.

A far less satisfactory indication, yet one which may be of some value, is the extent of the manifestation of some of the effects of corrosion on various plumbing fixtures. For instance, numerous complaints of green stains on white porcelain fixtures is an indication of corrosion of copper or brass pipe. The presence of excessive iron in solution results in numerous complaints of brown stains on plumbing fixtures and the staining of clothes in the process of laundering.

2. **Evaluation of Anti-Corrosion Treatments.** Where steps are taken to reduce the corrosiveness of the water by chemical treatment or otherwise, it is essential that adequate data be obtained to determine the effectiveness of such treatment. As previously indicated, the effects of corrosion are manifested in various ways and after various time intervals. Whether treatment has resulted in a decrease in the corrosion, pitting, or tuberculation in the mains and service lines can be determined only after a period of several months or years. It must be borne in mind that when treatment is begun, the piping system consists of mains and service lines of various metals in varied condition with respect to corrosion. Some may already be badly pitted or tuberculated; some may be relatively free from pits or tubercles; all have coatings of corrosion products, pipe growths, or organic matter of difference densities and protective value. Therefore, when the water applied to such a system is treated to alter its corrosive properties, the manifestation of this change in corrosiveness will be varied and difficult to evaluate immediately. The longer the interval of treatment, the clearer will be the picture of the relative effectiveness of the treatment. Where the treatment has been accompanied by a program of main cleaning, or flushing, some of the immediately apparent effects may be due merely to such cleaning. Any other steps taken in conjunction with the corrosive correction treatment, such as elimination of dead ends, should also be properly evaluated in the over-all picture.

In general, the change in the corrosive effects of a water on a piping system can be evaluated only after a period of possibly six months or a year, when a reduction in the frequency of the occurrence of leaks in service lines, clogging and corrosion of the meter parts, clogging of piping, or loss of water pressure at taps

*Not to be confused with the jar test for determining coagulation dosages.

indicates the effectiveness of the corrosive correction treatment.

The effectiveness of the treatment first manifests itself in improvement in the condition of the water as drawn from taps throughout the systems. For this purpose it is desirable that as an aid in the determination of the improved water quality certain representative taps be chosen with respect to the type and condition of the water-supply lines of the system and samples of the water be drawn from them under standard conditions of flow for a period of time before treatment is begun. After treatment has been instituted, additional samples can be taken under the same conditions and the change, if any, in the quality of the water can be noted. Such a sampling program should be well planned as to representative samples and be carried out for a sufficient period of time before and after treatment to give a proper picture of the condition of the water. Tests for the various metal ions as well as the dissolved oxygen content will be especially valuable in this work.

3. **Relation of Measurements to Consumer Complaints.** As previously indicated, corrosive action is continuously occurring when metal piping is in contact with water. The extent of the action varies with the type of piping and the character of the water supply. The point at which a water is considered sufficiently corrosive to require corrective treatment is quite dependent on the particular community concerned. The waterworks superintendent is concerned especially with corrosion of piping as a cause of leaks or breaks that require repairs, the clogging or corrosion of meter parts, and the tuberculation or clogging of mains and service lines. The consumer, on the other hand, is especially aware of corrosion as it affects the quality of the water. Thus the staining of clothes or of plumbing fixtures by iron or copper compounds is apt to cause complaints to the water department. The appearance of sediment, such as iron rust due to sloughing off of deposits in pipes, will cause considerable objection. There is usually no close relationship between the extent of the corrosive effects, the number of complaints, and the consequent public pressure to require corrective treatment of the water supply. Because of the variation in public reaction to the effects of corrosion, caution must be exercised to avoid evaluating the effects of corrosive treatment solely on the basis of consumer reaction. While the incentive for initiation of corrective treatment in many cases comes from the reaction of the consumers, consumer opinion is not too reliable an index of the effectiveness of the anti-corrosion treatment. Reduction in the number of complaints about the appearance of the water and the staining of clothes and fixtures is of value in judging the effectiveness of treatment, but the chief reliance should be placed on the analytical data concerning the water at the various taps before and after treatment. In any case, a sufficient time interval should be allowed before deciding on the effectiveness of treatment, because, as has already been indicated, corrosion is a very slow process and many of its effects are not manifested until an interval of months or years has passed.

II. FUNDAMENTAL REACTIONS OF CORROSION

No metal is truly stable in the presence of moisture and oxygen, and all metals tend toward ultimate conversion to oxides, hydroxides, or salts of the metallic element, with consequent destruction of the integrity of the metal. There are some metals for which this conversion is so slow that it may be regarded as substantially non-existent; unfortunately all of these are sufficiently rare and expensive to be unavailable for general waterworks use. Those metals that are normally within the economic reach of the waterworks engineer are all subject to corrosion, and the differences among them are small compared with the differences between them and the so-called noble metals.

The most widely accepted theory of the mechanism of corrosion may be called the electro-chemical theory; this theory is supported by an imposing array of observation and experiment. It represents the corrosion reaction as proceeding in a series of four well-defined steps:

Step I—Anodic Reaction. This is the release of metal ions, each carrying one or more positive charges, to the water, together with the liberation of an appropriate number of electrons, each carrying a single negative charge, to the main mass of the metal. It takes place entirely on the surface of the metal. It is represented below for some of the common metals, the term e signifying an electron:

Iron:	$Fe(metal) \rightarrow Fe^{++} + 2e$	
Zinc:	Zn " $\rightarrow Zn^{++} + 2e$	
Lead:	$Pb \rightarrow Pb^{++} + 2e$	
Copper:	$Cu \rightarrow Cu^{++} + 2e$	
Aluminum:	$Al \rightarrow Al^{+++} + 3e$	

Step II—Cathodic Reaction. The accumulation of electrons in the metal would soon stop the action by building up a negative charge high enough to prevent the further release of positive ions by sheer electrostatic attraction. However, in the presence of water the surplus electrons can be eliminated by reaction with hydrogen ions from the water. Since the electrons can move freely through the metal, the site of this reaction is not necessarily limited to the same area as that of the anodic reaction and, indeed, often takes place at some distance from it. The reaction is the same for all metals:

$$2H^+ + 2e \rightarrow H_2(gas)$$

When corrosion takes place in a strongly acid solution, the bubbles of hydrogen gas can be seen to form and break away from the surface of the metal. In all other circumstances the hydrogen is removed by another mechanism and may possibly never exist as a gas in the true sense.

Step III—Depolarization. Accumulation of the hydrogen film on the metal again would break the corrosion chain if it were not rapidly eliminated. In the presence of dissolved oxygen this elimination takes place by the reaction of hydrogen and oxygen to form water. The reaction is the same for all metals:

$$2H_2 + O_2 \rightarrow 2H_2O$$

Step IV—Reactions of the Metal Ions. Most of the metal ions released to the water undergo various reactions with ions present in the water. Many of these reactions result in insoluble products that coat the metal and protect it against further corrosion; often the apparent resistance of the metal to corrosion is due to the formation of such coatings. On the other hand, some of these insoluble products crystallize in such a highly pervious form that they are of limited value as a protection; iron rust is a good example. The real objective of much of the anti-corrosion treatment of water is to form impervious coatings of one kind or another on the metal by reaction with the substances introduced into the water. A few of the possible reactions of the various metals in natural or treated waters are given here:

Iron: $2Fe^{++} + \frac{1}{2}O_2 + 4OH^- \rightarrow 2H_2O + Fe_2O_3$ (rust)
or $2Fe^{++} + \frac{1}{2}O_2 + 4HCO_3^- \rightarrow 2H_2O + 4CO_3 + Fe_2O_3$
Zinc: $5Zn^{++} + 6OH^- + 2CO_3^= \rightarrow 2ZnCO_3 \cdot 3Zn(OH)_2$ (basic zinc carbonate)
Lead: $Pb^{++} + CO_3^= \rightarrow PbCO_3$ (lead carbonate)
or $3Pb^{++} + 2CO_3^= + 2OH^- \rightarrow 2PbCO_3 \cdot Pb(OH)_2$ (basic lead carbonate)
Copper: $2Cu^{++} + CO_3^= + 2OH^- \rightarrow CuCO_3 \cdot Cu(OH)_2$ (basic copper carbonate)
Aluminum: $2Al^{+++} + 6OH^- \rightarrow 3H_2O + Al_2O_3$ (aluminum oxide)

In the presence of other appropriate ions in the water, such as phosphate or silicate ions, insoluble compounds of the metals with these ions will be formed. None of these reactions will occur unless the necessary ions are present in the water in sufficient quantities.

Corrosion is thus seen to be a complex reaction composed of several steps. Interference with any part of the sequence will alter the course or rate of the entire reaction. This explains why corrosion is affected by a large number of factors, and why statements regarding it are so frequently conflicting or confusing. The conflicts come from disregarding factors which are not obvious but which affect materially some part of the sequence of reactions.

Factors That Influence the Steps in the Corrosion Sequence

Step I—Anodic Reaction. The tendency for a metal to release ions to water is a fundamental property of the metal itself. This tendency can be measured; it is called the oxidation potential of the metal. The noble metals are characterized by low values of the potential, the easily corroded metals by high values. Arranging some of the more common metals in order of decreasing tendency to release ions produces the following results:

Aluminum	Tin
Zinc	Lead
Chromium	Copper
Iron	Silver
Nickel	Gold

If no steps other than the release of ions were involved in corrosion, this series would represent the comparative susceptibility of these metals to corrosion. However, other factors complicate the picture. Aluminum, zinc, and chromium all appear ahead of iron in this series and on this basis alone would be expected to be more susceptible to corrosion than iron, but all three of these metals are much more corrosion-resistant than indicated by their position, because in step IV of the sequence they form impermeable films of oxide or other compounds, whereas iron does not. Under circumstances which prevent the formation of these films, the three metals take their proper place in the series. Such conditions are, however, not likely to occur in practice; hence these metals enjoy a high reputation for resistance to corrosion. Alloying of a metal with another will also alter its relative position in the series.

Step II—Cathodic Reaction. The ease with which hydrogen can be deposited on various metal and other surfaces is subject to considerable variation. It is, for example, more difficult to deposit hydrogen on zinc or tin than on iron, and easier to deposit it on certain oxides of iron than on the metal itself. This accounts in part for the protective action exercised by galvanizing or tinning, and for the localized corrosion or pitting produced by a piece of mill scale on an iron surface. In the latter case the mill scale becomes a cathodic area at which hydrogen is discharged, and the anodic reaction is concentrated in areas near the piece of scale, resulting in a strongly localized attack. Similarly, if two different metals are placed in contact with each other, the one lower in the series shown previously will become the cathodic area and the attack will be concentrated on the one higher in the series.

The rate of discharge of hydrogen is also influenced by the hydrogen-ion concentration (or the pH value) of the water in contact with the metal. Three ranges of hydrogen-ion concentration can be distinguished:

1. The acid range, corresponding to pH values of about 4.5 or lower. In this range the rate of corrosion is directly related to the hydrogen-ion concentration and the hydrogen is evolved directly as gas.

2. The intermediate range, from a pH value of about 4.5 to one of about 10.0. In this range the importance of the hydrogen-ion concentration is small compared to that of other factors, and the corrosion rate varies little, if at all, with pH value. Sometimes this fact is obscured by the influence of the pH value on the formation of protective films of certain types, notably carbonate and silicate films.

3. The alkaline range, corresponding to pH values of 10.0 or greater. In this zone the formation of hydroxide, carbonate, or other films is a direct function of the pH value, and corrosion accordingly again depends greatly on the pH value.

Step III—Depolarization. In waters possessing pH values between 4.5 and 10.0 the depolarization of hydrogen by dissolved oxygen is of great importance to the corrosion sequence. The oxygen concentration and the velocity of flow, which determines how fast fresh oxygen is brought to the metal, both exert a great influence on the rate of corrosion. Complete removal of dissolved oxygen from water will substantially eliminate its power to attack metals in this zone of pH values. Unfortunately, complete removal of dissolved oxygen is seldom feasible in waterworks practice.

If the concentration of oxygen varies at points along the surface of the metal, the areas where the concentration is high become cathodic areas and those where it is low, anodic areas. The attack is concentrated at the anodic areas, and pitting is produced.

Step IV—Reactions of the Metal Ions. Corrosion can be stopped very effectively if a layer of impervious non-metallic material is interposed between the metal surface and the water. Obviously such a material—for example, asphalt or cement—may be deliberately applied to the metal; the effectiveness of such a coating will depend on the imperviousness of the material and the care with which it is applied.

Many of the metals, under suitable conditions, will react with components present in the water to form impervious films that protect the metal from further attack. A complete catalogue of such films would be a major undertaking, but a few of the more common ones may be mentioned here. Films made up of oxides or hydroxides of the metal are numerous; aluminum, chromium, zinc, and iron are familiar examples. Carbonates or basic carbonates of the metal are also common, such as, for example, those formed by zinc and copper. Under special conditions, films of metal silicates and phosphates or of metals combined with organic radicals may be encountered.

In other cases the protecting film may be formed entirely from substances present in the water, without much involvement of the metal ions; examples are the films of calcium carbonate or silicate produced by certain types of anti-corrosion treatment of the water and the protection afforded by some types of organic compounds.

These protecting films vary tremendously in thickness; furthermore, some are effective barriers against corrosion when only one molecule thick, whereas others are relatively ineffective even when present as a heavy deposit. The composition of the water and numerous other factors affect the stability, composition, and physical structure of the films. In short, it is this latter step in the corrosion process that exhibits the greatest complexity and accounts for most of the observed variability in the total rate of attack on metals.

(Part III of this report will be published in the next issue. It will deal with methods of mitigating corrosion.)

WATER WORKS PLANNING FROM A COMMISSIONER'S VIEWPOINT*

by

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THE term, "planning," suggests different things to different people.

Some consider planning the expansion of water facilities to be entirely unproductive and, thus, wasteful. They would postpone all planning and relegate the timing of actual studies to that future day when those facilities are required immediately. Nothing should be done, they believe, until public pressure for expansion of facilities is so great that the need can no longer be ignored.

You water works men have always been noted as being imbued with the desire to give your best not only to your superiors but to the people you serve, so that your water systems will produce the most gallons of water at the least possible cost.

Whether the water system be large or small, the pattern of good management is always the same. That pattern involves furnishing at all times an adequate supply of water at the least possible cost.

To fit into such a pattern, the planning for future water requirements must take into consideration these four important aspects, no one of which is not dependent upon the others:

Material Aspects
Monetary Aspects
Political Aspects
Legislative Aspects

Taking these in turn, an integrated plan for future construction can be developed.

Material Aspects

The material factors involved in planning are those which concern the facilities of the system itself. Included are the following factors:

Age, Condition & Maintenance of System

When lack of capacity becomes evident, the first items to check are the age, condition and maintenance of existing facilities.

Water works men should, as they do, carefully watch the relation of flow to sizes of pipe so that they may know when decreases in flow are due to tuberculation or incrustation, to loss in pumping efficiency or other similar causes.

A primary question, then, is whether or not expansion is required rather than merely the cleaning or replacement of present facilities.

Capacity of System

Next, the capacity of the existing water system should be checked with respect to present and future demands.

Loss in capacity by leakage (and in many systems this is considerable) is a serious matter, which may, however, sometimes be considered a blessing in disguise. A careful leak survey may disclose enormous losses, disproportionate with those normally expected in the particular system. This unmetered and unpaid-for water may represent the difference between a surplus or a deficit in the operating revenues of the system. Many municipalities have, as the result of leak surveys, been able to discover the sources of greatest loss, eliminate them and, thereby, stave off expenditures for additional facilities that would otherwise have been required.

(Our own experience has been that of reducing a water loss of almost 48 per cent to one about 15 per cent within the last eight years. Most of this saving was accomplished during the war years, when labor and materials were at a premium and under priority, so that we were able to meet our increased demands without new facilities.)

The capacity of a well designed water system should, in addition to taking care of normal demands, provide a reserve pumping or delivery capacity of from 75 to 100 per cent above normal consumption. For this purpose balancing reservoirs or storage tanks are great assets, which should be considered in planning any development of the system.

Toward the provision of such excess capacity, the water works man should bring his best powers of persuasion to bear upon those in authority who must approve funds for future development. Every system should be blessed with some emergency capacity and all plans for future expansion should be made in time to ward off encroachment of increased demands upon such reserves.

No matter how vigorously you must emphasize your increased water needs to do this, the effort will be worth while. Protection of those reserves is the only way in which your emergency needs can be met when the occasion arises.

Community Growth & Water Demands

The trend of community growth in most cases follows a consistent pattern. For large cities, the curve of growth shows a gradual almost straight-line rise. For small communities, increases are usually small at first, then spurt. The curve representing future water demands, of course, generally parallels the growth curve of the community served.

Such indications of growth, together with studies of the total area served for an indication of kind of growth—industrial or domestic—provide a reasonable basis upon which to plan future expansion.

Reports & Recommendations

On the basis of such studies as above described, and on the basis of your own experience with the specific problems of your own water system, you will be able to prepare intelligent reports and recommendations to your controlling officers. And if, in these reports, you take into account all the various factors pertinent to your recommendation, you can exercise a real influence upon their decision.

Your Controlling Officers

How can I, a commissioner, feel competent to suggest to you water works men means of attacking problems of water works engineering and development that are primarily your own? Only because these suggestions are based on the orderly process of thinking that I, as a sponsoring authority, have humbly learned over the years, from you, to be the best approach to an understanding of the factors involved in planning for present and future water needs. And, of

*This paper was presented before the New Jersey Section of A.W.W.A. and is here published by permission of the Association.

course, I know first hand that these are some of the things which you should marshal on your side in attempting to sell your plans to those in authority.

Quite frequently your commissioners or controlling officers will be men elected or appointed to office, although they have no engineering training or conception of engineering functions connected with public works or, more specifically, with water works operation and development. If such a commissioner is to sponsor the things that you have planned for the best operation of your plant and future water service, you *must* acquaint him with all the steps by which you developed your plan for the recommended expansion of facilities.

If you are fortunate, your sponsoring officer will be an engineer, who will be able to grasp your plans quickly. Then if he disagrees with you and tells you why he disagrees, weigh his thoughts carefully. His decision must be final, so if you cannot see eye to eye with him, salvage the most you can out of your plan and back him up when he makes the official proposal of it. Even if only part of your plan is put forward, remember that there are many days and months and even years ahead in which to see all of your ideas (and ideals) accomplished.

It has been my experience that the most can be accomplished by planning the best, proposing those projects which you feel sure are best, doing the most you can with what you get, and continuing on from any temporary setbacks, using to best advantage the facilities and tools available. Because a water system is flexible, you can almost always go around another way. And though what you get now plus what you get later may cost more than what you originally had in mind, you can ultimately reach the goal you set out to accomplish.

If your commissioner or controlling officer has *no* engineering conception of your plan, your lot will be harder. Fortunately, however, the men elected or appointed to municipal offices today are usually successful business men, who, though they may find it difficult to think in terms of engineering developments, are capable of keen and sound judgment of what you are trying to sell them. Thus, it is up to you to sell them your plan in terms of future water needs of your community.

Monetary Aspects

Your commissioners or governing authorities must equate the material necessity for future water works construction with the general overall picture of municipal finances.

If the water utility is a profitable enterprise, the annual surplus of revenue received over operating cost can well be balanced against the cost of future improvements. Fluctuation in construction costs must also be considered and a reserve from surplus must be set aside to meet the "rainy day" storms of general economic conditions.

No water utility should be operated at a loss.

Rates should be such that they will return sufficient funds to care for the operating costs, the debt service requirements of the utility, and to provide a sum equal to at least 2 per cent of the total capital investment of the utility for normal repairs and minor betterments plus such amounts as will be required to provide the larger outlays for major future expansion.

If the reserve account grows out of proportion with the cost of recommended future construction, it should, of course, be reduced to the proper amount and the surplus turned over to the general municipal fund for tax-reducing purposes.

Political Aspects

It may well be asked why politics should enter into the development of a water supply. It shouldn't, but it does.

Where water service is municipally controlled, the relation between earnings and the tax rate is a most sensitive one. If the utility operates at a deficit, the deficit must be met by a general tax levy. If the utility is profitable, its surplus revenues almost always are the subject of anxious glances by others than the water commissioners as a possible means of reducing the tax rate.

Any utility, public or private, however, should set aside part of its surplus revenues for betterments of the system. And that's where planning plays a vital part. If you know what your financial needs will be, you can plan ahead to have sufficient reserves on hand when projects must be started.

Unfortunately, it is the policy of many municipal officials to dip into the water utility reserve, transferring funds from it into the unanticipated revenue account for tax reduction purposes. And the lack of a water works reserve, of course, means expensive piecemeal expansion and very little economical planning. Without reserve funds it is painful to obtain approval of any program and more difficult yet to obtain the funds necessary for the work.

Where utility revenues could, if properly preserved, be applied, I always look upon bond issues as a very expensive way of getting public improvements. I consider it, in fact, another form of deficit spending.

Thankful is the sponsoring officer and the water works man for a sympathetic group of municipal officers who are always alert to the present and future needs of the water utility and strong and wise enough to set aside such surpluses as will provide for an orderly and economical expansion of the water system.

Legislative Aspects

I have already pointed out the advantages of having a commissioner or controlling officer with an engineering background.

I have pointed out, too, that when the surplus revenues of a water department are diverted to other municipal channels, that action is taken at the expense of proper functioning of the utility.

Further, it should be noted that another factor operating against proper development of large water supplies is the lack of a strong state authority to regulate, to construct storage facilities for, and to apportion the total water resources of the state.

To remedy these faults, the following state laws should be advocated:

1. A law to make it mandatory that a municipal officer who serves as a public works officer or is otherwise in control of a public utility be a professional engineer.

2. A law to control the amount of money that may be taken from the surplus revenues of a water department.

3. A law to set up a strong state authority with power to condemn property, to construct and operate large water supply projects, thus to make available for potable water supply purposes all those waters of the state the use of which would require projects too large for any single political division or group of political divisions to finance and operate.

In Summary

All factors discussed should be taken into consideration, but two points should be emphasized above all others:

Plan carefully now for your future requirements, be sure they are the best, then start fighting *five years ahead* of the time you want any facility to make sure that you will have it when you need it.

Your problems are your commissioner's problems. Go hand in hand with him as a joint sponsor of water works projects and the success of your utility will be assured.

A.W.W.A. BOARD ACTIONS

WITH 36 of the 39 members attending, the Board of Directors of the Am. Water Works Assn. went into session at noon on Sunday, the 15th of January, and worked through until noon Tuesday, the 17th, to accomplish a number of things. Amongst these was the release of a strong realistic statement to the press wire services, concerning the water supply shortage of New York and other cities. This statement emphasized the need of public interest in and support of long range planning of adequate water supplies, and the economic importance of adequate water supply distributed through non-leaking piping systems to metered consumers. It also emphasized the inadequately recognized importance of an adequate water supply to the well-being of industry as well as that of commercial interests and the people at large.

Pres. Elect
W. Victor Weir
President
St. Louis Co. Wtr. Co.
Univ. City, Mo.

Vice-Pres. Elect
Albert E. Berry
Chief Engr.
Ont. Dept. of Hlth.
Toronto

Diven Medalist
Joseph P. Schwada
City Engr.
Milwaukee, Wis.

Hon. Member
Geo. W. Pracy
Genl. Mgr. & Ch. Engr.
Dept. of Water
San Francisco

Hon. Member
John H. Murdoch, Jr.
Chief Attorney
Am. Water Works Co.
New York

Hon. Member
Jack J. Hinman, Jr.
Consulting
Chem. Engr.
Iowa City, Ia.

Early in the meeting the following were chosen officers of A.W.W.A. for the year which will begin at the close of the 1950 Convention in Philadelphia, May 21-26.

For President
W. Victor Weir, St. Louis, Mo.

For Vice-President
Albert E. Berry, Toronto, Ont.

For Treasurer
Wm. W. Brush, New York City

Honorary Memberships were voted three members of distinction—

Geo. W. Pracy*

Jack J. Hinman, Jr.*

John H. Murdoch, Jr.**

*Past-presidents A. W. W. A.
**Pres., Pa. W. Wks. Assn.

The **John M. Diven Medal** was voted to—

Joseph P. Schwada, Milwaukee, Wis.

—"in recognition of an outstanding service to the Association, as represented by his effort expended in directing his committee in the preparation of revised specifications for Laying Cast-Iron Water Mains, and for his meticulous care, exacting detail, and frank and courageous presentation of the problems involved, and defense of the committee's recommendations."

The **Goodell Prize,** awarded for the year's most notable contribution to the science or practice of water supply development, was voted the Association's special Committee on Water Fluoridation whose report and recommendations were published in the July 1949 Journal under the title "Fluoridation of Public Water Supplies — A Statement of Recommended Policy and Procedure." Those comprising the committee were—

A. P. Black, Chairman

L. H. Enslow	H. A. Faber
W. V. Weir	R. J. Faust
A. E. Berry	H. T. Dean

The award committee also accorded honorable mention to two other contributions—"A New Method of Taste and Odor Control," by D. B. Williams (May 1949 Journal) and "Bacteriacidal Effects of Chlorine Dioxide," by G. M. Ridenour and E. H. Armbruster (June 1949 Journal).

The **Awards to Sections,** comprising the Hill Cup for the best record in membership gains during the year, and the Henshaw Cup for the highest ratio of members to non-members attending its annual meeting, were both won by the **Arizona Section.** In second and third places in the Hill Cup competition were the new Chesapeake Section and the hustling Ky.-Tenn. Section. In second and third places in the Henshaw Cup competition were the Montana and the Cuban sections.

The "Old Oaken Bucket Award" as in the past 10 years was won by California—as the largest section. The Board, therefore, voted the Californians permanent possesion of the Old Oaken Bucket which was procured only after much searching of the countryside of New England for the "genuine thing." (Just another case of an "Easterner" gone West, never to return.)

The Board heard some good news from Secretary Jordan relating to the sustained membership growth to a new high of almost 8,000 members at the year's end. More importantly it learned that the drifting-out of members had been less percentage-wise in 1949 than in years past, meaning that membership gains are becoming of a more permanent nature.

The Board passed a budget of approximately $240,000 for the year 1950, after learning of increased income from Journal advertising, and again found no reason to raise dues even in the face of a substantial increased cost of printing the Journal and other increasing expenses incident to running any enterprise these days.

In the increased budget $5,000 is allocated for continuation of the "Public Relations at Work" program; $2,500 for the study of Compensation of Water Works Personnel, begun late in 1949; $2,500 for the Advancement of Water Works Schools—in all a $10,000 allocation voted to "Development Expense."

The Board heard with great satisfaction that the pension plan put into effect during 1949 for Association employees had been approved by all authorities as legally, actuarially and financially sound.

The **General Policy Committee** (L. H. Enslow, Chairman) presented a

new formula for the selection of personnel making up technical committees of the Association, with particular reference to equitable technical representation of equipment and materials manufacturers on standardization committees charged with the development of A.W.W.A. standards and specifications. The proposal received unanimous approval of the Board. Also there was approval of the Committee's recommendation that the Canadian Section be permitted to establish "Branches" of the Section, in order to more adequately serve the water works men in the Dominion's wide-flung territory.

The meeting closed with excellent and inspiring progress reports and recommendations by the Water Works Practice Committee (L. R. Howson, Chairman), and the newer **Committee on Water Works Administration** (W. R. La Due, Chairman).

"Jo" Knox Appointed Secy. N.E. Pollution Control Commission

Joseph C. Knox, long-time associate sanitary engineer with the Mass. State Health Dept., and well known Secretary of the New England Water

Works Assn. has been appointed to the new $8,000 per year position of Exec. Secy. of the recently established New England Water Pollution Control Commission.

This newest of the interstate anti-pollution agencies is composed of representatives from the states of Massachusetts, Connecticut, Rhode Island and New York. Already the Commission has approved grants for research on industrial waste treatment to Wesleyan Univ., Middletown, Conn., and Rhode Island State College, Kingston, R.I.

The work of the Commission is to be financed through pro-rated appropriations from the participating states and U.S. Govt. contributions under Public Law 845. Headquarters will be located in Boston, Mass.

ELUSIVE MANGANESE

Which Shows Up With Superchlorination But Cannot be Detected With Standard Methods.

Concerning Mr. Gard's "Experiences With Break-point Chlorination,"* he has apparently experienced the same confusing problem as we have. Upon adoption of super-chlorination the filter sand becomes coated with a dark brown material, giving a very positive test for manganese, yet no trace of manganese could be found in the raw water.

The above phenomena has been going on in our plants since we began super-chlorinating. We are using water from both the Patuxent and Anacostia Rivers, which requires normally 5 to 9 p.p.m. of chlorine in our raw water super-chlorination, and sometimes as high as 12.5 p.p.m. of chlorine is necessary. In doing so we get a very black deposit, which penetrates through 24 inches of filter sand and another 18 inches of graded gravel. This black deposit seems not only to adhere to the sand, but a certain portion of the deposit appears on a nuclei of what is believed to be aluminum hydroxide floc. All of the black deposits we knew had come from the raw water, yet by following the conventional oxidation methods of analysis (including a procedure approved by "Standard Methods for the Examination of Water and Sewage") we could not detect manganese in the raw water.

At the present time we are successfully finding manganese in our raw water by altering the procedure a bit. By evaporating a 100 ml. sample of water in the presence 1 cc of conc. sulfuric acid and 2 or 3 drops of conc. nitric acid, then volatilizing the residue at 500° F. or just below red heat until all nitrogen oxides and sulfur dioxide fumes are driven off (approx. 10 min.) we have decomposed the syrupy residue. If we dissolve this unvolatilized residue with 10 cc of hot 1% sulfuric acid and proceed with the Periodate Colorimetric Method of analysis, we can successfully convert the manganese compounds to permanganates in measurable quantities.

It is my thought that these findings may be of interest to other laboratories that have encountered the same or a similar problem.

S. M. MILLS, Chemist,
Washington Suburban Sanitary Dist.,
Hyattsville, Md.

*Published in the Nov. 1949 issue of "Water & Sewage Works."

Worn by the Best N.Y. City Houses.

Well, Sue. I believe in being prepared for the worst. This water shortage is getting more serious every day. Never realized before how really valuable just one tub of water could be if you didn't have it.

"Wally" Miller to Rochester, N.Y.

W. T. (Wally) Miller has resigned as Superintendent of the Board of Water Commissioners of Ossining, N.Y. to accept the position of Superintendent of the Lake Ontario Water Co., Rochester, N.Y. In his new ca-

pacity, Mr. Miller replaces Alex Russell, who resigned Dec. 31.

"Wally" Miller has been associated with the Village of Ossining since his graduation from New York University in 1926, first as Construction Engineer and since 1933 as Supt. of Water. During the War, Miller was on leave of absence and served for three years as Asst. Civ. Engr. and Public Works Officer with the Navy Civil Engineering Corps.

A member of A.W.W.A. since 1933, Miller is now a Director for the New York Section. He has been a Trustee of the N.Y. Section since 1940 and served as Chairman in 1943 and 1946.

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AT YOUR
Service
Full of water speed to you
By pumps of every type.
Behind your water faucet
Are miles and miles of pipe.
I like to know my "salary"—
That ease-o-monthly charge—
PAID
Is earned by honest effort
And not by leakage large.
Introducing
"WILLING WATER"
DEVISED BY THE AMERICAN WATER WORKS ASSOCIATION
TO PERSONIFY THE SERVICE OF THE WATER INDUSTRY
VERSES ADDED BY THE INDIANAPOLIS WATER COMPANY, 1947
The water's safe for drinking—
There's not a harmful germ:
Purification takes 'em out,
As numerous tests affirm.
I'm not confined to "home-work";
I serve the city wide,
Move the wheels of industry—
And am the fireman's pride.
My name is Willing Water;
My job is never done.
Around the house I'm handy—
Regardless of the work,
I do my job with pep and vim
For I'm not one to shirk.
I plan to meet the need, as
Indianapolis grows—
My intent for future years:
Be sure the water flows!
Ev'ry hour of day or night,
I'm always on the run.
Though most the time I'm happy,
Sometimes I feel chased
Because some thoughtless person
Has let me run—unused!
When you're in need of service,
You can rely on me.
I've planned for years to be
prepared
For days of scarcity.
WILLING WATER SAYS:
Safe water
Delivered day n' night
Costs less
Than anything else you buy
INDIANAPOLIS WATER COMPANY

An Example of How Willing Water Can Be Put To Work

(This 12 page booklet is used by the Indianapolis Water Co. to bring the story of its service to its customers)

ON BUYING PLANT EQUIPMENT

An Open Letter from One Superintendent to Another*

Dear "Bill":

At the Section meeting last month, the editor of *Water and Sewage Works* magazine asked me to write an article on "Buying Water and Sewage Works Equipment." He said to make it an A, B, C sort of story on how to specify and buy the *best* equipment for water and sewage plants, and at the same time give the taxpayer the most for his money in the long run.

Now you know I'm not much of a writer but he kind of intrigued me, so I said I'd try. At first, I felt that I didn't have anything of real interest to write about, but later, in recalling how careful I had been recently in spending my own money for a new deep freeze unit, it seemed to me that buying equipment for the plant is actually no different and that maybe we are doing all right when we follow the same scheme in spending the taxpayers' money.

I'd plan to start off my article with my own experience in what, to me, was the bewildering field of refrigeration which went something like this: First, I knew I didn't want my family to take chances on spoiled food—I guess you and I as water supply men always think of the health angle first—and I couldn't afford to get a unit that might go bad and ruin several hundred dollars worth of food. So above all, I wanted *dependability*. Then, of course, I wanted a unit that would be economical and easy to take care of and, even though I'm reasonably handy with tools, I wanted one made by a reputable company that would always have parts and service available—and I mean service *right now*, not a week away. In other words, I wanted dependability and service of the same kind we need in waterworks equipment. Finally, the freezer had to be nice looking and convenient to use, so my wife would be proud to show it off to her friends.

Well, after deciding on the things I wanted, I started looking. I read sales literature, talked to the salesmen and saw demonstrations, but I still couldn't make up my mind. Then I had a good idea. I went to see some service men and refrigeration engineers to find out what they thought. At the same time, I looked up a little about the experience and background of the companies that made the units and talked to people who had units of the kinds I was considering, and I'll tell you, it didn't take very much of that sort of investigating to convince me of the importance of the company behind the product. Of course, that shouldn't have been new to a water works man.

On paper some of the freezers seemed to be pretty much alike, except that some were considerably cheaper than others. However, when I checked operating costs with the power company, maintenance experience with the service men, and looked up the stability and engineering and development background of some of the makers, I could see that the well-known names in the field didn't get their reputations for dependable equipment and good value just by accident. That's why I bought the freezer I did and not one of those that sounded a lot cheaper when comparing "price tags."

That's about the story of the deep freeze, Bill, but if I write the article on water or sewage works buying, I could easily go on and tell how the same consideration and study applied there could save a lot of headaches.

For instance, there's always the problem of price. Too often someone in City Hall simply says "take the low bid," when you and I feel pretty certain that a few more dollars spent initially could mean a world of economy and better performance later. That's just one of the perenial questions and there are lots of others equally as important. I don't see why anyone should argue "take the low bid." When a private company buys they don't buy that way. So I thought I might finish up my article with just an outline of things to be considered. Maybe it would help some of the fellows whose councils preach "take the low bid" and don't look behind the curtain so to speak.

Here are some of the points I thought I'd cover:

1. Write specifications that cover exactly what is needed for the job to be done.—Not, just general functional specifications that can be met by inferior design or construction at a lower initial price.
2. Examine the technical literature describing the proposed equipment and then go to visit nearby installations of types similar to that being considered. Check the quality of workmanship and materials and look for unique design features. Ask other operators about ease of maintenance, operating costs, and *dependability* of operation. Get the opinions of technical men and consultants.
3. Examine the background of the equipment. Ask some of these questions: Has the proposed equipment been thoroughly tested and proved? How long has the particular type been in operation? Where are some of the places it is installed? Is it approved by interested health authorities? Will replacement parts always be available?
4. Inquire thoroughly into the service facilities, experience and integrity of the bidder. What facilities does he have for research and development work to ensure that the proposed equipment is up to date? Is his manufacturing plant and equipment capable of turning out the precision work required for sound equipment? Does he maintain an adequate, conveniently located service and technical organization? How many years experience has he had in the field? Does he have a full line of equipment so that he can offer *exactly* the right equipment for the job needs? Is his equipment generally used so that he will have had wide contact with similar problems? Is he reliable and well established in the field? Is he known for honesty and fair dealings in the conduct of his business? Is the firm a member of the Water and Sewage Works Mfgrs. Assn., which investigates all firms before they are admitted to membership?

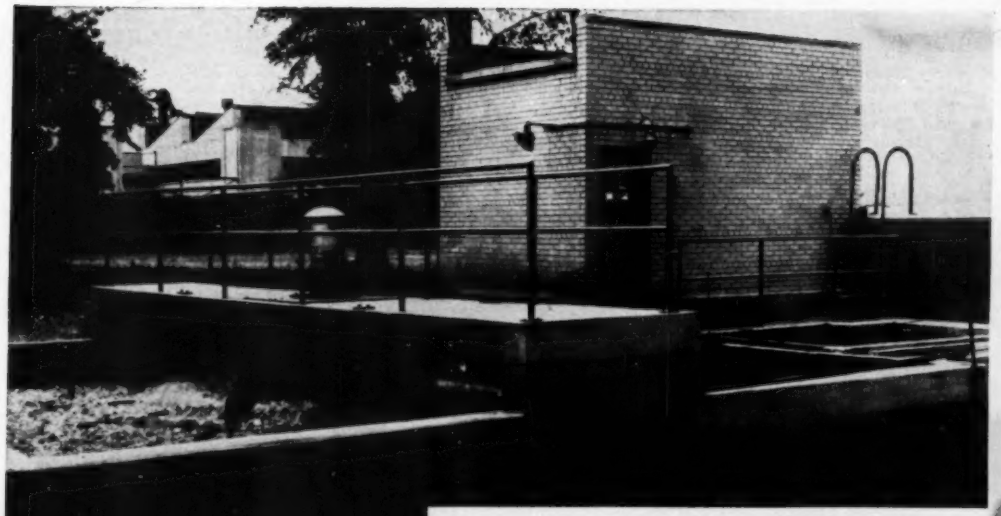
I'm sure there are other more or less intangible points that ought to be covered too, and I'd like to have your suggestions on a matter of such importance. It seems to me that to follow some such guide would be helpful to all of us in not necessarily buying the lowest initial cost equipment, but certainly we would get the most in the long run for the taxpayer's dollar; and, without doubt, the most dependable equipment to carry out the responsibilities of our jobs.

Let me know what you think about it Bill.

Yours,

"Tom."

*Ed. Note: This is a "Dear Bill" letter such as we published a series of a few years ago. Upon request of readers we are starting these "Open Letters" again. The author can remain unidentified, as was agreed to in this case if it is so desired.



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Operator training service by Chicago Operating Sanitary Engineers is provided with each plant. Ingenious automatic features of Chicago "Pakage" plants simplify operation and assure successful performance.

Aeration and clarification are performed in a single tank with positive, automatic sludge control. One sludge setting covers a wide range of sewage flows and strengths. Since 1934 over 200 plants have been installed and are successfully operating.

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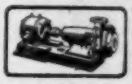

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MEETINGS SCHEDULED

FEB. 7-8—PORTLAND, ME. (P.W.D. Service Bldg.)
Maine Water Utilities Association. Sec'y, Earle A. Tarr, Supt., Winthrop, Me.

FEB. 15—NEWARK, N.J. (Essex House)
New Jersey Section A.W.W.A. (Annual Mid-Winter Luncheon Meeting) Sec'y, C. B. Tygert, P.O. Box 178, Newark, N.J.

FEB. 16—BOSTON, MASS. (Statler Hotel)
New England Water Works Association. Sec'y, Jos. C. Knox, 204 Tremont Bldg., Boston 8, Mass.

MAR. 12-16—COLLEGE STATION, TEXAS (Texas A. & M.)
Texas Water & Sewage Works Association. Sec'y, V. M. Ehlers, State Dept. of Health, Austin, Texas.

MAR. 16—BOSTON, MASS. (Statler Hotel)
New England Water Works Association. Jos. C. Knox, 204 Tremont Bldg., Boston 8, Mass.

MAR. 22-24—TRENTON, N.J. (Stacy-Trent Hotel)
New Jersey Sewage Works Association. Sec'y, Michael S. Kachorsky, P. O. Box 283, Manville, N. J.

MAR. 30-31—ROCHESTER, N.Y. (Sheraton Hotel)
New York Section A.W.W.A. (Spring Meeting). Sec'y, R. K. Blanchard, 50 West 50th Street, New York 18, N.Y.

MAR. 30-31—WINCHESTER, VA. (Geo. Washington Hotel)
Virginia Industrial Wastes & Sewage Works Assn. Sec'y, A. H. Paessler, 815 E. Franklin St., Richmond 19, Va.

MAR. 31-APR. 2—SAFFORD, ARIZONA
Arizona Sewage & Water Works Association. Sec'y, Helen Rotthaus, San. Eng. Div., State Capitol, Phoenix, Ariz.

APR. 3-5—NIAGARA FALLS, ONTARIO (General Brock Hotel)
Canadian Section A.W.W.A. Sec'y, Dr. A. E. Berry, Parliament Buildings, Toronto, Ont.

APR. 4-7—ST. LOUIS, MO.
National Association of Corrosion Engineers. Sec'y, A. B. Campbell, 919 Milam Bldg., 803 Texas Ave., Houston, Texas.

APR. 12-14—CHICAGO, ILL. (LaSalle Hotel)
Illinois Section A.W.W.A. Sec'y, Carl N. Brown, U. S. Pipe & Foundry Co., 122 So. Michigan Ave., Chicago, Ill.

APR. 17-19—LITTLE ROCK, ARK. (Robinson Memorial Auditorium)
Arkansas Water & Sewage Conference. Sec'y, Prof. Harrison Hale, 118 Chemistry Bldg., Fayetteville, Ark.

APR. 20—BOSTON, MASS. (Statler Hotel)
New England Water Works Association. Sec'y, Jos C. Knox, 204 Tremont Bldg., Boston 8, Mass.

APR. 20-21—SALINA, KANSAS (Lamar Hotel)
Kansas Sewage Works Association. Sec'y, James B. Arbuthnot, State Board of Health, University of Kansas, Lawrence, Kansas.

APR. 20—MISSOULA, MONT. (Florence Hotel)
Montana Sewage Works Association. Sec'y, H. B. Foote, State Board of Health, Helena, Mont.

APR. 21-22—MISSOULA, MONT. (Florence Hotel)
Montana Section A.W.W.A. Sec'y, C. W. Brinck, State Board of Health, Helena, Mont.

APR. 26-28—LAFAYETTE, IND. (Purdue University)
Indiana Section A.W.W.A. Sec'y, C. H. Bechert, 445 N. Pennsylvania, Room 200, Indianapolis 4, Ind.

MAY 3-6—LONG BEACH, CALIF. (Lafayette Hotel)
California Sewage Works Association. Sec'y, Lawrence H. Cook, P. O. Box 696, Menlo Park, Calif.

MAY 10—TACOMA, WASH. (Winthrop Hotel)
Pacific Northwest Sewage Works Association. Sec'y, W. P. Hughes, City Hall, Lewiston, Idaho.

MAY 11-13—TACOMA, WASH. (Winthrop Hotel)
Pacific Northwest Section A.W.W.A. Sec'y, O. P. Newman, Boise Water Corp., Boise, Idaho.

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MEETINGS SCHEDULED

MAY 21-26—PHILADELPHIA, PA.
American Water Works Association (Annual convention). Executive-Secretary, Harry E. Jordan, 500 Fifth Ave., New York 18, N.Y. (Meetings & Exhibits in the Auditorium.) All reservations will be cleared through the A.W.W.A. Headquarters.

MAY 22-24—TRAVERSE CITY, MICH. (Park Place Hotel)
Michigan Sewage Works Association. Sec'y, D. M. Pierce, State Dept. of Health, Lansing 4, Mich.

JUNE 6-8—AUBURN, ALA. (Alabama Polytechnic Institute)
Alabama Water & Sewage Works Association. Sec'y, Alex O. Taylor, Alabama Polytechnic Institute, Auburn, Ala.

JUNE 9-10—INDIANAPOLIS, IND.
Central States Sewage Works Association. Sec'y, Paul W. Reed, 1098 W. Michigan St., Indianapolis 7, Ind.

JUNE 22-24—CINCINNATI, OHIO (Gibson Hotel)
Ohio Sewage & Industrial Wastes Treatment Conference. Sec'y, G. A. Hall, 302 Dept. of State Bldg., Columbus, Ohio.

JUNE 29—DOVER, N.J. (Germania Park)
New Jersey Section A.W.W.A. (Clambake and Outing). Inspection Trip, Lock Joint Pipe Co., Wharton, N. J. Sec'y, C. B. Tygert, Box 178, Newark, N. J.

AUG. 20-22—STATE COLLEGE, PA. (Nittany Lion Inn)
Pennsylvania Water Works Operators Assn. Sec'y, Prof. Robert E. Stiemke, Dept. of Engineering, State College, Pa.

AUG. 23-25—STATE COLLEGE, PA. (Nittany Lion Inn)
Pennsylvania Sewage & Industrial Wastes Assn. Sec'y, B. S. Bush, Penna. Department Health, Kirby Health Center, Wilkes-Barre, Pa.

SEPT. 7-8—SARANAC LAKE, N. Y. (Saranac Inn)
New York Section A.W.W.A. (Fall Meeting) Sec'y, R. K. Blanchard, 50 West 50th Street, New York, N.Y.

SEPT. 19-21—DAVENPORT, IOWA (Hotel Blackhawk)
Iowa Sewage Works Association. Sec'y, Leo Holtkamp, E. Ohio Street, Webster City, Iowa.

SEPT. 26-29—ATLANTIC CITY, N. J. (Claridge Hotel)
Pennsylvania Water Works Association. Sec'y-Treas., C. M. Hartman, 510 Telegraph Bldg., Harrisburg, Pa.

OCT. 1-3—ST. LOUIS, MO. (Sheraton Hotel)
Missouri Water & Sewage Conference. Sec'y, Warren Kramer, State Office Bldg., Jefferson City, Mo.

OCT. 9-12—WASHINGTON, D.C. (Statler Hotel)
Federation of Sewage Works Associations. Exec.-Sec'y, W. H. Wisely, 325 Illinois Bldg., Champaign, Ill.

OCT. 15-18—NEW ORLEANS, LA. (Roosevelt Hotel)
Southwest Section A.W.W.A. Sec'y, Leslie A. Jackson, Robinson Memorial Auditorium, Little Rock, Ark.

OCT. 26-28—ATLANTIC CITY, N.J. (Hotel Madison)
New Jersey Section A.W.W.A. Sec'y, C. B. Tygert, P.O. Box 178, Newark, N. J.

NOV. 13-15—DURHAM, N.C. (Washington Duke Hotel)
North Carolina Section A.W.W.A. and North Carolina Sewage Works Association. Sec'y, E. C. Hubbard, State Board of Health, Raleigh, N. C.

NOV. 17-19—MESA, ARIZONA
Arizona Sewage & Water Works Association. Sec'y, Helen Rotthaus, San. Eng. Div., State Capitol, Phoenix, Ariz.

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FOR SEWER LINES

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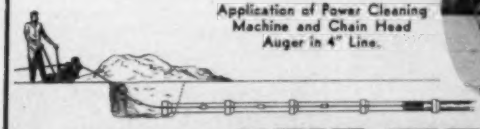

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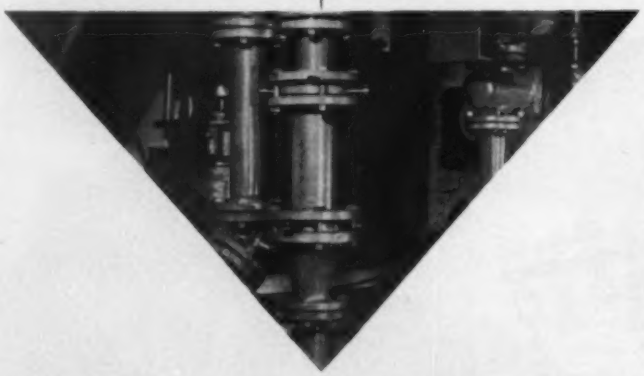

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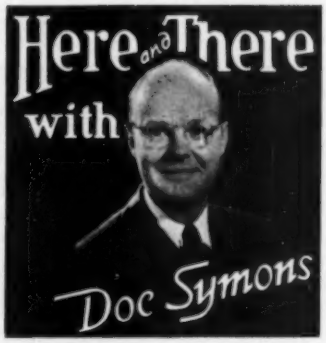
another DOW product



Here's **T**hat **M**an **A**gain—And you won't believe this, but deadlines being what they are, I'm writing this effusion on New Year's Day 1950. As a matter of fact, I almost wrote this on New Year's Eve, but instead, as the New Year broke across the nation, I did some work for The Federation's "Pete" Wisely.—How come, you say?—My girl Gin has been bedded since Christmas day with a severe case of Coryza and Laryngitis, so I celebrated at midnight with a cup of coffee (I'm a tea drinker, you know) and a piece of pumpkin pie.

* * *

I've already wished you a prosperous New Year and so for this moment I'd just like to visit with you. As many of you well know, I'm a thoroughly sentimental guy—I like Christmas and Christmas cards, and I read every one I received. Thanks to all of you. If I may pick out one that impressed me very much, I'd like to mention the one from L. S. (Ducky) Duckworth, Supt. of Filtration at Lancaster, Penna. There's a fellow who really knows his public relations and it bubbles over in his Christmas cards. Every year when I get his card, I'm tempted to use it as a spring board for editorializing on public relations, but I'll spare you this time.

* * *

One of the presents under our Christmas tree was a case of Heineken's beer sent to me by the late J. W. (Jake) Van Atta. For those of you who read our manufacturers' news items in January, you know that "Jake" (or "Jack") died suddenly early in December. Readers of this column know "Jake" as the fellow whose cry of "Council Bluffs" on the train trip to the 1947 Conventions in San Francisco was the beginning of the **Society of Council Bluffers.** "Jake" was the current vice president of this gang who took the trip together in July '47. Without him—well the Council Bluffers will miss him—and not only will he be missed

by us and the R. B. Carter Co. of which he was Exec. Vice President, but there will be an empty space in the hearts of a lot of other persons who knew him as a friend.

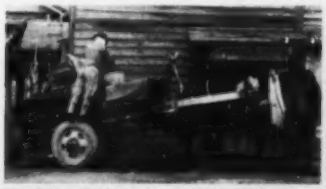
* * *

Up at the Boston meeting of the Federation there was an interesting and memorable meeting of a very select group of persons. All six of the living professors of sanitary engineering of Mass. Inst. of Tech. had lunch together. Here is a picture of four of them

reading from left to right: Rolf Eliassen, W. S. (Bill) Stanley, T. R. (Tom) Camp, and R. G. Tyler. Missing here are George Sampson and Richard Gould. Eliassen and Stanley are now at M.I.T., Camp and Sampson are consulting engineers in Boston, Tyler is Professor of San. Engr. at the University of Washington, and "Dick" Gould is Director of the Bureau of Sewage Disposal of New York City.—As if you didn't know.

* * *

Following the appearance of a picture in the July column, p. 76A, I received the following letter: "Doc (H.T.M.A.)—Been hearing a lot about that 'Order of Honey Dippers' back state-side (July '49 issue). Thought you might like to see a couple of pix of our Oriental Dippers.—Van K. Tharp, San. Engr., Hokkaido Civ. Affairs District, Sapporo, Hokkaido, Japan."



Looking again at the pictures above, I'm reminded of the meeting of the Iowa Sew. Wks. Assn. in Des Moines, where Prof Jack J. Hinman Jr. (of

Having SLIDE RULE trouble?

When the problem is moving air or gas, turn to *R-C dual-ability* for accurate, dependable answers

That's one job we know, inside-out. For almost a century, we've been air-and-gas specialists, exclusively. Without being immodest, we think our engineers are the best informed in the industry, on blowers, exhausters, gas pumps and related equipment.

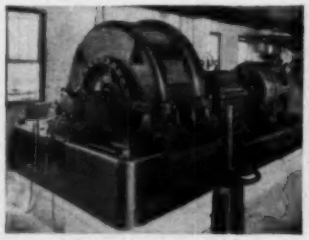
They have an extensive line to draw on, too. They make unbiased recommendations between Centrifugals and Rotary Positives—we're the only company offering this *dual choice.* With capacities ranging from 5 cfm to 100,000 cfm, we can supply standard units closely matched to the job, for efficiency and economy.

As to how R-C equipment performs, our old-time, repeat customers are the best answer to that. They'll testify that you will reduce your buying and operating problems when you call on R-C air-and-gas specialists.

ROOTS-CONNERSVILLE BLOWER CORPORATION
502 Mount Avenue, Connersville, Indiana

CENTRIFUGAL

2-stage Centrifugal Blower with capacity of 13,500 cfm. in sewage treatment plant.



ROTARY

Rotary Positive Blower used in water treatment process. Capacity 300 cfm.

ROOTS-CONNERSVILLE BLOWER BUILDERS SINCE 1854

ONE OF THE DRESSER INDUSTRIES

HARDINGE CLARIFIERS

for

water supply . . . waste water.

Hardinge Steel-Tank Clarifier Reclaiming Colliery Wash Water

• In industrial areas, Hardinge Clarifiers have proven their worth in the treatment of industrial water supply. Also used in the recovery of valuable suspended solids from industrial waste water, they frequently leave the effluent clear enough for reuse in the process.

• Hardinge Clarifier systems are relieving stream pollution in many localities.

• Available with either steel or concrete tanks, Hardinge Circular Clarifiers are usually equipped with cut-flight scrapers which remove settled solids rapidly through a central discharge. Can be used in conjunction with chemical treatment and flocculation.

State your water treatment problem and write for Bulletin 35-C-15.

HARDINGE
COMPANY INCORPORATED

YORK, PENNSYLVANIA—240 Arch St. • Main Office and Works
NEW YORK 17—122 E. 42nd St. • 205 W. Wacker Drive—CHICAGO 6
SAN FRANCISCO 11—24 California St. • 200 Bay St.—TORONTO 1

Iowa City, not Ames, Iowa) gave an illustrated lecture on the same subject. Jack tells listeners that they can remember how to pronounce his name by remembering that his name would be Thinman, except that he can't qualify.

Jack told the audience that in Japan things are a bit different: the "back house" is in the front yard, and the wife is called "Lady Back of the House."

* * *

Out at the Purdue Industrial Waste Conference in November, R. W. (Ray) Hess, Waste Supervisor for the National Aniline Div. in Buffalo, N.Y. failed to show up to perform his duties as the presider at two sessions. Don Bloodgood, Chairman, of that now famous series of conferences, impressed me into service to fill Ray's shoes.

That gave me the opportunity to introduce Dr. Ruth Patrick, Curator of Limnology, at the Philadelphia Museum of Science, as the only lady member of the **Sludge Shovelers Society,** she having been inducted with the Ceremony of the High Hat at the Penn State Meeting of the Penna. Sew. and Ind. Wastes Assn. last August.—And if I may say so, the audience for her paper at Purdue was not only big, but impressed.

* * *

I. O. (Bert) Lacy, Supt. Sew. Treatment Wks., Lockport, N.Y., and one of "the Boys" in the Western Section of the NYSSWA, was preparing a paper on the history of the Erie Canal for presentation before the Niagara Co. Historical Society, and he dug up the information that an Army man by the name of Symons did the survey for the ship canal idea. —Might be some relation. "Bert also dug up the following information from the *Lockport Courier and Journal* of Nov. 16, 1859—"The Aurora Borealis, that paradox of the philosopher-astronomer has at last been fully explained and accounted for. A scientific writer thus clears up the hitherto mysterious phenomenon quite to the satisfaction of every logical mind. When the melofygistic temperature or our horizon is such as to calcorize the impurient indentation of the hemispheric analogy, the borax curbistus becomes surcharged with infinitesimals, which are thereby deprived of their fissural disquisitions. This effected, a rapid change is produced in the thorabumpter of the gyasticutis palerium, which causes a convalcular in the hexagonal antipathies of the terrastrium acqua versuli. The clouds then become a mass of deodorumised specilae of cormocular

light which can only be seen when visible."

And for you more conservative gentlemen who look down on modern double talk, take another look at the date on that newspaper,—Nov. 6, 1859.

* * *

Back to the Federation Meeting in Boston for a moment. If you were there, you saw the Link-Belt exhibit where they had a jar of ball bearings and offered a pen set to the person guessing the nearest to the number of balls. Actually there were 1134 balls, and Mr. Albert Tom, Research Asst. at M.I.T. guessed 1135. This information was imparted to C. C. Agar, of the N.Y. State Health Dept. by Joe Gilbert, of Link Belt. Mr. Gilbert's letter to "Charlie" was addressed to C. C. Agar, Chief Eater Pollution Control, etc. Anyone looking at Charlie's protuberance might suspect that it was not just a typographical error on Joe Gilbert's part. Right Joe?

* * *

Did I ever tell you that R. Y. (Bob) Sigworth, Supt. of Utilities at Penn State College is a member of my N.O.B.D. club, you know—the Nimble Order of Bum Digits.—Also W. D. Hebig, Supt. of Sewage Treatment at Cresco, Iowa.

* * *

If you read my November Column you will understand the following letter which I received shortly after that issue hit the newsstands.—"Dear Doc: Subject; H.T.M.A. in Nov. issue. Recognition of a critical condition which I can not condone is the cause of my correspondence concerning your column — clearly that I may contribute certain constructive comment.

"The brutal fact is that, for some time, I have suspected murderous tendencies in your nature. (Ever since you cut off Harry Jordan's hands.) Now my suspicions have been confirmed by the lower photograph you published on page 80A of the Nov. issue.

"Clever though your composite photograph is, it cannot conceal the sadistic pleasure you derived from amputation of the violinist's left hand. (As far as I can tell, his right hand may be gone, too.) Even more subtle is your implication that he is a 'violinist extraordinary'—as a result of the amputation, I presume.

"Doc, before it is too late, cease this needless mangling of helpless humanity. Otherwise a new lead line for your column may be justified. 'Here's That Murderer Again.'—Signed: Harry A. Faber."

Here's all you need to repair a KENNEDY SAFETOP after collision damage...

Only one man with a socket wrench

a large screwdriver

a light sledge hammer

one collision breakage repair kit (breaking ring, coupling, 2 pins, gasket)

and 30 minutes

More and more communities standardize on KENNEDY SAFETOP Fire Hydrants because SAFETOPS are proved dependable under the most rigorous conditions . . . and because SAFETOP maintenance and repair features are simplified for greater economy and efficiency.

Write for Bulletin 62 describing *all* the details of the KENNEDY SAFETOP'S design and construction. No obligation!

THE KENNEDY VALVE MFG. CO.
1036 EAST WATER ST.
ELMIRA, NEW YORK
VALVES • PIPE FITTINGS • FIRE HYDRANTS

OFFICE-WAREHOUSES IN NEW YORK, CHICAGO, SAN FRANCISCO • SALES REPRESENTATIVES IN PRINCIPAL CITIES

The name of Black and Veatch has long been an important one in the field of sanitary engineering. Down at the Washington meeting of the new Chesapeake Section of A.W.W.A., I caught a picture of Black & Veatch, and herewith show you same.

Black and Veatch

Wrong Black, you say?—Yes we know that Tom Veatch's capable partner, E. B. Black, passed away last year but these two are a couple of important "guys" in the field of Sanitary Engineering, and we couldn't resist the play on names. Of course you know that the above are: A. P. Black, Head, Dept. of Chem., Univ. of Fla., and Pres. of A.W.W.A., and N. T. Veatch of Black & Veatch, Engrs., and Past President of A.W.W.A.

* * *

Am looking forward to seeing all of you at some convention, somewhere, sometime during 1950.

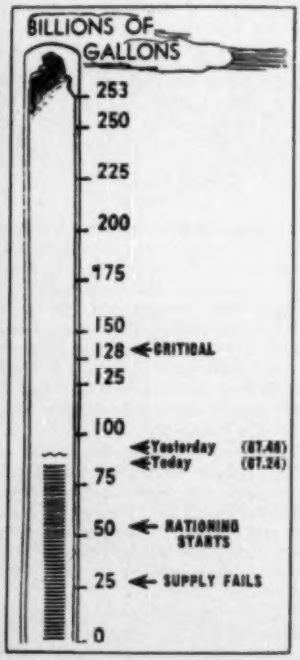
V.T.Y.—Doc.

THE SPILLWAY

[Overflow from the main section]

Watch That Water Level!!

The above graphic illustration has been running in the New York *World Telegram* to daily remind New Yorkers of their dwindling water supply.



From a full reservoir capacity of 253 billion gallons the supply has shrunk to the critical 87.24 billion registered the day before Christmas.

At 54 billion, New Yorkers will be rationed water at reduced pressure and by various contemplated measures. With 25 billion left in the reservoirs faucets in many parts of N.Y. City will go dry.

"BAD METER FREEZE-UP, HARRY?"
"NO SUCH THING AS A 'BAD FREEZE-UP', JOE, WITH THE SIMPLICITY OF BUFFALO'S FROST BOTTOM METERS."
Any freeze-up is less trouble when simply-designed American or Niagara FROST BOTTOM Meters are used. All working parts are fully protected against frost damage, and meters can be returned to service with a minimum of cost and delay.
AMERICAN (Bronze Case) WATER METERS
NIAGARA (Galv. Iron Case) WATER METERS
BUFFALO METER CO.
2909 MAIN STREET, BUFFALO 14, N. Y.

Here's the Key to...

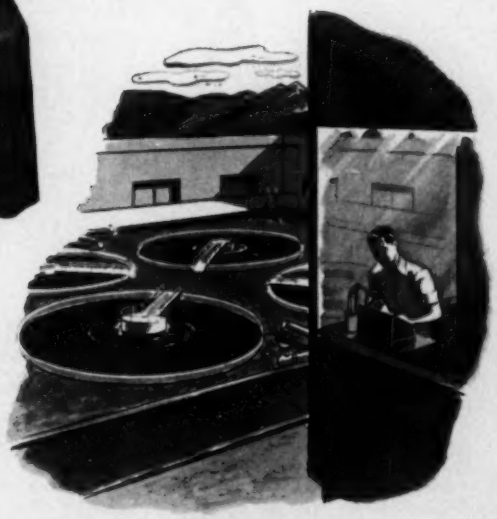
√ Lower Treating Costs

√ Higher Plant Efficiency

√ Important Savings in Chemicals

in both small and large plants

BECKMAN pH CONTROL



THE BECKMAN MODEL H-2 pH METER is one of a complete range of Beckman pH Meters available for every type of application*. The H-2 is particularly recommended for applications where high accuracy and simple operation—combined with the convenience and low cost of 115-v. AC operation—are desired.

It provides instant and direct pH readings, and a simple, built-in dial permits quick, convenient temperature compensation over the entire range of 0° to 100°C (32° to 212° F.). High reading accuracy is assured by wide-spread dual range scale that reads from 0 to 8 pH or from 6 to 14 pH at the turn of a switch. Same switch also provides instant millivolt readings from 0 to ±800 mv and from ±600 to ±1400 mv for titrations and oxidation-reduction measurements.

Built-in electrode support and compact case design save valuable space and permit easy portability to various plant locations.

Particularly important is the wide range of factory-sealed, maintenance-free Beckman Glass Electrodes available for use with this instrument . . . electrodes that are virtually unbreakable . . . that cover extreme temperature ranges from below freezing to above boiling . . . that have an unprecedented pH range with negligible errors . . . that are abrasion-resistant and chemically durable to a degree never before thought possible in glass electrodes.

*In addition to the H-2 Meter, other Beckman pH equipment includes completely automatic pH indication and control instruments for large-scale process applications . . . battery-operated models for complete portability in plant and field use . . . and a laboratory type instrument that features maximum versatility and accuracy for research and laboratory applications

Regardless of whether your plant is large or small . . . regardless of whether you are building a new plant, modernizing present equipment or making the most of what you now have, remember this—**no water or sewage plant is completely modern without Beckman pH Control!**

IN WATER TREATING OPERATIONS accurate pH control is important in every one of the major treating steps. Each Coagulation process has its own narrow pH limit at which maximum floc and settling rate occur. In Softening—whether lime-soda, zeolite or organic ion exchange—optimum results can be obtained only with modern pH control. In Neutralization, accurate pH control is essential to regulate the process to changes in pH of the incoming water and to insure a neutral finished water that minimizes corrosion in mains, pipe lines and industrial operations.

IN SEWAGE TREATING OPERATIONS and industrial waste disposal, accurate pH control is essential for optimum sludge digestion, for minimizing odor, for obtaining maximum settling and filtration, for assuring proper clarification and neutralization of effluent before discharge into rivers—all at lower chemical costs and greater plant efficiency.

Do you have a copy of this informative booklet?

It contains a great deal of helpful data on the application of pH control to modern water and sewage processes and discusses the various methods used. Your authorized Beckman dealer will be glad to supply you with a copy and to give any assistance you may wish in the application of pH control to your particular operations. Or write direct. **Beckman Instruments, National Technical Laboratories, South Pasadena 20, Calif.**

BECKMAN INSTRUMENTS
control modern industries

Beckman Instruments: pH Meters and Electrodes — Spectrophotometers — Radioactivity Meters — Special Instruments

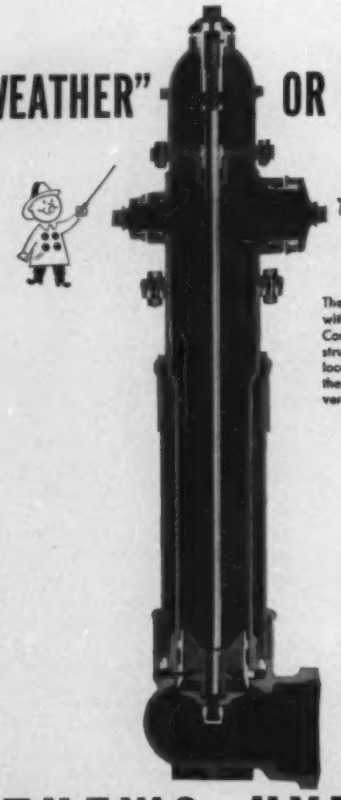
St. Louis to Modernize Water Works at Cost of $15,000,000

Most of Which Has Accumulated in the Water Dept. Reserve Fund

It is far too infrequent that a lead line like that above can be written. Many a water works superintendent will be keenly envious of Thos. L. Skinker, Supt. of the St. Louis Water Dept., that has to its credit the tidy sum of $14,000,000 which has accumulated from *earned surplus* over a period of years. Needless to say this fund has been eyed hungrily by those who would throw most of it into the general fund and reduce taxes.

Amongst the planned improvements, scheduled for a 7 year program, the earliest will be an increased pumping capacity by 50% and conversion of steam stations to motor driven pumps, at a cost of $700,000. The old Chain of Rocks Filter Plant and Pumping Station will be rejuvenated throughout, including the safety measure of raising all basin and filter walls above possible flood levels, at a cost of $2,000,000.

We understand that brother "Tom" Skinker at St. Louis has a yard so full of good old C.I. pipe, already bought with surplus funds, that it makes the pipe yards of the Birmingham plants look like "pikers."



"WEATHER" OR NOT

The protection case is free to move with ground heaves caused by frost. Complete drainage, leakproof construction, the shield operating nut, and location of the operating thread above the stuffing box, all combine to prevent rust or ice from forming.

MATHEWS HYDRANTS

Made by R. D. Wood Company
Public Ledger Building, Independence Square
Philadelphia 5, Pa.
Manufacturers of "Sand-Spun" Pipe (centrifugally cast in sand molds) and R. D. Wood Gate Valves

THE FIREMAN'S FRIEND

Mathews Modernized Hydrants Set the Pace: Easily maintained, because simple in construction • All working parts contained in replaceable barrel • Stuffing box cast integral with nozzle section • Head can be turned 360° • Replaceable head • Nozzle sections easily changed • Nozzle levels raised or lowered without excavating • Protection case of "Sand-Spun" cast iron for extra strength, toughness, elasticity • Operating thread only part to be lubricated • A modern barrel makes an old Mathews good as new

2nd Inter-American San. Engineering Congress

Scheduled for Mexico City Mar. 16 - 26

The Mexican Section of the Inter-American Assn. of Sanitary Engineering will be host to the Second Inter-American Sanitary Congress to be held in Mexico City, Mexico between Mar. 16 and 26. Sponsoring agencies also include, beside the AIDIS, the Mexican Dept. of Hydraulic Resources, the Mexican Div. of Inter-American Cooperation, the Mexican Dept. of Foreign Relations, the Governments of the States of Mexico and Michoacan, and the Pan American Sanitary Bureau.

The second Congress will follow the pattern of the first, held in Santiago, Chile in 1948. A balanced program has been planned to appeal to all persons in the field of sanitary and public health engineering. Inspection trips are planned to Public Works at Xochimilco, Sanitary Engineering Works at Nevcalpan, Cuantitlan, and Tlalnepantla, and the water works at Morelia as well as the Lerma Aqueduct and other points of interest.

For further information on the Congress direct inquiries to the Conference Chairman and President of the Mexican Section, AIDIS, Mr. Alberto Ortiz Irigoyen, Calle de Campeche 244, Mexico, D.F., Mexico, or to Ralph J. Van Derwerker, Secy., Inter-American Assn. of Sanitary Engineering, 2001 Connecticut Ave., N.W., Washington 8, D.C.

It Was Bound To Happen

Tripure Products Co., a bottled water plant in Miami, Fla., is offering a sodium fluoride treated water under the trade name "Fluori-Dent" Water. Distribution of the fluoridized water in 5 gal. bottles began in September 1949. Chemical determinations of the fluoride content of the water, made up in batches of 450 gals., are made on the water before and after fluoride treatment by chemists of the Tripure Products Co. and by the State Health Dept. Laboratory.

Bulletin on POROUS MEDIA by CARBORUNDUM

TRADE MARK

NO. 7 FEBRUARY, 1950

Announcing Improved Air Diffusers

A new, superior ALOXITE aluminum oxide diffuser material is the most recent development of extensive research by The Carborundum Company. The *average* pore size is larger for any given permeability rating to assure decreased clogging and easier cleaning. Yet there is no appreciable increase in bubble size to lower oxygenation efficiency. Along with this improved characteristic, *one of the most uniform bodies ever produced* has been achieved.

When introduced many years ago, ALOXITE plates and tubes met diffuser requirements so successfully that they became the leading product in the field. In the interim, experience has modified early ideas of plant and equipment operation. Diffuser clogging, for example, is now recognized and treated as a somewhat normal operational factor.

This revised concept points to the use of diffusers such as the new ALOXITE units that clog less readily and clean more easily. These improved diffusers still maintain balance between smallest possible bubble diffusion and other requisite properties of good uniformity, high strength and low pressure loss. They still provide the basic advantages realized from the original ALOXITE diffusers.

Such an improvement follows a policy of keeping pace with general advances in the science of sewage aeration. Now available, these superior ALOXITE diffusers offer a better "tool" for more efficient operation.

Properties of ALOXITE Porous Media

MATERIAL	Ceramically bonded crystalline aluminum oxide grain of controlled sizes.
GRADES (Pore size)	Filter Underdrains ... coarse and very coarse. Direct Filtration ... range from very fine to medium. Diatomite Support ... range from fine to medium. Air (gas) Diffusion ... range from fine to coarse (permeability from 10 to 120.)
SOLUBILITY	In Water and Air ... insoluble at all normal operating temperatures. In Acids ... generally resistant at all operating temperatures, except to hydrofluoric acid. In Alkaline Solutions ... ceramic bonds are progressively soluble with time and temperature increases.
STRENGTH	Transverse breaking strength is relatively good ranging from 1000 lbs./sq. in. (coarse grades) to 3000 lbs./sq. in. (fine grades).
REFRACTORINESS	All grades withstand up to 900° C. without softening.
THERMAL SHOCK RESISTANCE	Withstand changes up to 20° C./hr. (Where more severe heat shock exists, ceramically bonded silicon carbide porous media are available.)
POROSITY	Ratio of pore volume to total volume of all grades approximately 35%.
DENSITY	Approximately 0.09 lbs./cu. in.

"Carborundum" and "Aloxite" are registered trademarks which indicate manufacture by The Carborundum Company

ALOXITE Diffuser Bubbles ...

During 1949 a method was developed for cleaning cemented-in diffuser plates in place by oxyacetyline flame spalling of top surface. This was accomplished by Linde Air Products Company in cooperation with the Department of Public Works of New York City. It is applicable if and where sewage characteristics and/or conditions of operation result in serious top (liquor side) clogging of non-removable plates.

Pre-aeration of raw sewage by diffused air before settling is now receiving well earned recognition. Besides accomplishing several well known objectives, it is lower in cost per additional unit of solids and BOD removal by primary settling, than any other step of preliminary or complete treatment.

Small ALOXITE diffuser or aerator stones are again available in two shapes, spherical (1" dia.) and cylindrical (⅜" dia. x 1" lg.). These are very useful for aeration experiments or maintaining oxygen in BOD water. Plain stones can be obtained with a ¼" hole into which glass or metal air tubing can be cemented. Stones with nipple mounting for 3/16" rubber tubing are also stocked. Order through your regular laboratory supply dealer.

TECHNICAL DATA

on porous media and their application

is available on request. You may obtain any or all of the following engineering bulletins by writing Dept. O-20.

No. 1—Aeration of Sewage and Water.
No. 2—Underdrain Systems for Filters and Softeners.
No. 3—General Catalog information.

THE CARBORUNDUM COMPANY
Refractories Division
PERTH AMBOY, NEW JERSEY

MANUFACTURERS' and EQUIPMENT NEWS

201

Layout for Meter Repair Shop

Badger Meter Mfg. Co., Milwaukee 10, Wis. has available a blue print of a "Suggested Floor Plan for Meter Repair Shop." Measuring approximately 22 by 35 inches, this blueprint is complete with layout and design for constructing a meter repair shop. Specifications and information on Badger Meter Testers are also included.

To obtain a copy of this useful blueprint, use a Reader Service Card on which is entered the above key number and your name and address.

W. H. Brown Joins Builders-Providence

Walter H. Brown, Jr. has joined the staff of Builders-Providence, Inc., Providence, R.I., after resigning his position as Supt. of Sewage Treatment Works, Cranston, R.I. on Dec. 1. Brown served as President of the New England Sewage Works Assn. in 1949 and was host to the Federation meeting in Boston in October. A graduate of Brown University in 1933, Mr. Brown served as supervisory construction engineer during the building of the Cranston sewage plant and was named its first superintendent. His work at this plant is well known.

Mr. Brown is engaged in sales engineering with Builders and will devote his attention particularly to the company's products designed for municipal sewage and industrial waste treatment.

"Bill" Simpson, Mueller's 50 Yearman

Exec. V.P. Receives First Diamond Studded Emblem

J. W. ("Bill") Simpson, who advanced to executive vice-president of Mueller Co. of Decatur, Ill., from the job of errand boy for Hieronymus Mueller, founder of the Company, received a diamond-studded fifty-year emblem at ceremonies honoring long-time Mueller em-

Mueller's Simpson

ployees. Presentation of the emblem was made by Lucien W. Mueller, chairman of the board and a third generation member of the family

(Continued on page 99A)

CENTRILINE called to Cincinnati 5 TIMES IN 10 YEARS

In Cincinnati's program to recondition its water mains for greater efficiency and economy, Centriline has recently completed its fifth contract since 1940.

A total of more than 68,000 feet of cast iron pipe has been cleaned and uniformly lined with dense cement mortar in this city. Pipe sizes were from 24" to 48". On the last job, the average speed of lining was better than 1,000 feet per day . . . resulting in minimum interruption in water distribution.

Cincinnati has found that Centrilining pays. It will establish and maintain a high coefficient, reduce pumping cost, stop all leakage and terminate deterioration. Consult Centriline's experienced hydraulic engineers. A 28-page illustrated bulletin is also available on request.

CENTRILINE CORPORATION

A subsidiary of Raymond Concrete Pile Co.

140 CEDAR STREET, NEW YORK 6, N.Y.

Branch Offices in all Principal Cities in the United States and Latin America.

CEMENT MORTAR LINING FOR WATER MAINS CENTRIFUGALLY APPLIED . . .
In strict conformity with A. W. W. A. Specifications.

(Continued from page 98A)

which founded the company in 1857.

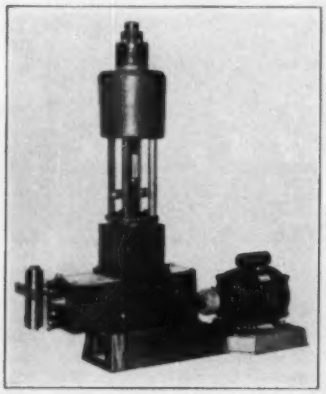
"Bill" Simpson's service with Mueller Co. dates back to August, 1899, when his first job was in the automobile shop of Hieronymus Mueller, who was then devoting a major share of his time to perfecting the once well known Mueller Motor Car.

After the death of the senior Mueller in 1900, young Simpson advanced through the positions of order writer, pricing clerk, sales correspondent, and then sales assistant to the late Adolph Mueller. By 1917 he had risen to general sales-manager of the company and became a Director in 1928. A year later he was named vice-president in charge of sales, and served in the dual capacity of vice-president and sales manager until 1947, when Hugh L. Baker was appointed general sales manager and Mr. Simpson was elected executive vice-president. In point of service he is Mueller's senior employee. In this period (1899-1949) the Company has expanded from a one plant operation to an organization with plants in Decatur, Los Angeles, Chattanooga (Columbian Iron Wks.), and Mueller, Ltd., of Sarnia, Ont.

202

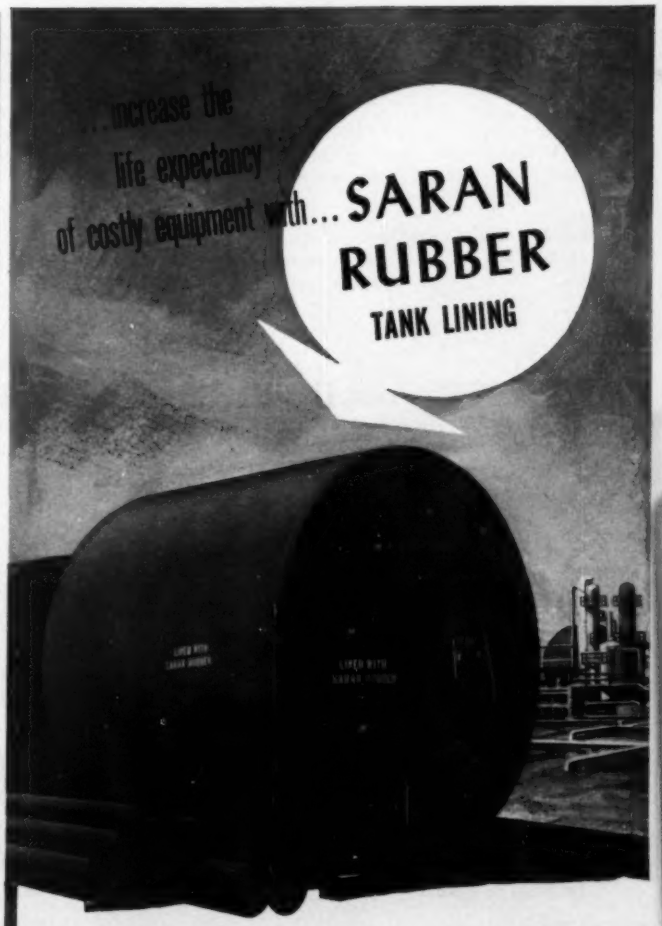
Pulsafeeder Chemical Control

Lapp Insulator Co., Inc., LeRoy, N.Y., has announced an accessory to the Pulsafeeder line. Known as the "Auto-Pneu-Matic" control system,



it provides for pneumatic instrument control of Pulsafeeder output.

An important feature of the Pulsafeeder pump design is its ability to adjust output while in operation. With this new device an automatic change in volume control is provided in response to instrument air pres-



Saran rubber, one of Dow Chemical's superior developments in tank linings, has combined the physical properties of rubber with the chemical resistance of saran. This high degree of chemical and abrasive resistance makes saran rubber an outstanding lining where resistance to grease, solvents, acids and other chemicals is indicated.

Saran rubber can be applied easily, effectively and economically by experienced tank lining applicators located strategically throughout the country.

Get in touch with an applicator today by contacting your nearest Saran Lined Pipe Company office —and find out how you can preserve the life of costly equipment.

Distributed by

Saran Lined Pipe Company

701 STEPHENSON BUILDING • DETROIT, MICHIGAN

Offices in: New York • Boston • Philadelphia • Pittsburgh
Chicago • Tulsa • Indianapolis • Houston • San Francisco
Los Angeles • Portland • Cleveland • Denver • Seattle
Charleston, S. C. • Toronto

DOW

sure change. It makes possible systems in which pump output is made responsive to any measurable variable, flow, pH, temperature change, liquid level, pressure or the like.

For further information on this new unit, use a Reader Service Card on which is entered the above key number and your name and address.

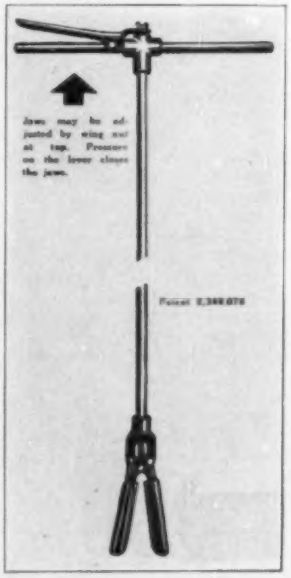
203
Deaerating Heater

Graver Water Conditioning Co., New York 11, N.Y. has developed a new deaerating heater design capable of reducing the oxygen content of boiler feed water to less than 0.005 ml. per liter regardless of rapid load variations or unusual operating conditions. Carbon dioxide is also completely removed. These results are provided by the new two-stage Graver Deaerating Heater.

To obtain further information on this boiler feed water heater, use a Reader Service Card on which is entered the above key number and your name and address.

204
Curb and Valve Box Cleaner

Joseph G. Pollard Co., Inc., New Hyde Park, Long Island, N.Y. is offering an improved curb and valve box cleaner. As shown in the accompanying photograph, the jaws may be adjusted by wing nut at the top. Pressure on the lever closes the jaws. The blades are drop forged and will stand hard usage. The unit will pick up stones, rubbish and dirt. It will operate in 2½ in. curb boxes and all size valve boxes, and may be obtained in either five or six foot lengths.



To obtain further information about this unit, use a Reader Service Card on which is entered the above key number and your name and address.

Graver Water Conditioning Adds to Sales Staff

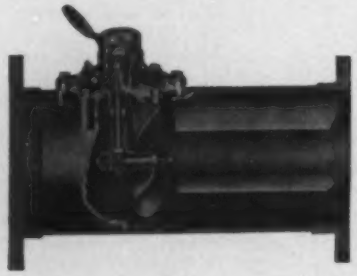
In the sales expansion program of Graver Water Conditioning Co. since its establishment as a separate division of Graver Tank & Mfg. Co., Inc., the concern has recently made several appointments of sales agents. These include: The Stapp Engineering Co., Denver, Colo.; J. R. Fortune & Son, Detroit, Mich.; Process Equipment Co., Tulsa, Okla.; Russell R. MacDonald Co., Richmond, Va.; and Brookman-Kron Associates, Buffalo, N.Y.

SPARLING MAIN-LINE METERS

SIMPLICITY

A Sparling Meter is as easy to install on your main-line as a length of the pipe itself. It is as easy to read as a house meter. And it is perfectly obvious—simplicity itself—in its action. The flow turns the propeller and this, through ball bearings and gears, advances the Totalizer.

Readings accurate within 2 per cent are assured with a minimum of cost for years to come.



Indicators and Records may be installed at any distance desired from the meter. Auto-metered chemical feed controls, too, may be added as required.

Quotations and Bulletin 310 come at your request

The SPARLING Manufacturers of WATER MEASURING EQUIPMENT

LOS ANGELES 54.....Box 1277 Terminal Annex — 622 Broadway.....CINCINNATI 2
CHICAGO 8.....1500 South Western Ave. — 101 Park Avenue.....NEW YORK 17
BOSTON 8.....6 Beacon Street — 1932 First Avenue.....SEATTLE 1
DALLAS 1.....726 Reserve Loan Life Bldg.

A. N. Zahniser Represents Dresser in New England

Dresser Mfg. Div. has announced the appointment of A. Newton Zahniser as Northeastern Representative in New England, Eastern New York and Eastern Pennsylvania.

Before joining Dresser, Mr. Zahniser was with the Wailes-Dove Division of Koppers Co., Inc.

205

Faceshields

Mine Safety Appliances Co., Braddock, Thomas and Meade Sts., Pittsburgh 8, Pa., has announced the M.S.A. Faceshields for protection in handling acids, chemicals, hot metal, sanding, grinding, degreasing, and all operations wherever face and eyes are endangered by light, flying particles. These faceshields are available in three standard headgear types —with full spark-guard, with semi spark-guard, and without spark-guard. All are fitted with clear vinyl plastic visors.

To obtain further information on this Faceshield, use a Reader Service Card on which is entered the above key number and your name and address.

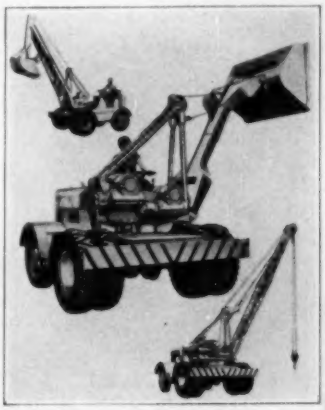
A. W. McLean of Layne & Bowler Dies

A. W. McLean, manager of Layne Western Co. at Chicago, died suddenly on Thanksgiving afternoon in Aurora, Ill. He was 68 years old and had spent forty-five years of his life in the well water supply and pump business. He was an accepted authority on water well construction in northern Illinois.

206

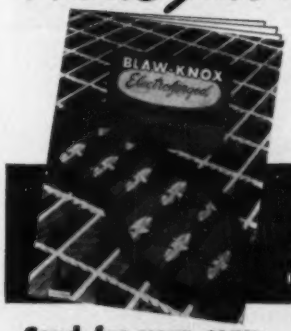
Swing Loader

The Mandt Mfg. Co., Columbus 8, Ohio, has announced the 1950 model Mandt Swing Loader, featuring full hydraulic operation, 180° swing and quick change convertibility to mobile crane or backhoe. As a loader, the unit is designed for a standard ¾-yard material bucket and up to 2 yard snow handling bucket, which is capable of



loading from any point in a 10 ft. wide swath and also above grade and can swing 90° to either side to dump. The utility of this machine for municipalities is increased by its quick convertibility to an excavator and trencher by installation of a ⅓-yard back-

Here's your Catalog for grating and stair treads



Full of applications, specifications and engineering data that will help solve your grating problems

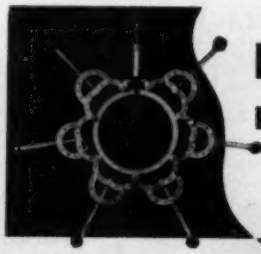
Send for your copy TODAY WHATEVER your grating problem . . . flooring, catwalks, stair treads, bridge surfacing, sidewalk doors, subway gratings, or any of the hundred and one uses for any industry . . . you'll want this big new Bulletin for complete information on construction details and *all* the advantages of Blaw-Knox Steel Gratings. Ask for Bulletin 2296.

BLAW-KNOX DIVISION
of Blaw-Knox Company
2061 Farmers Bank Bldg., Pittsburgh 22, Pa.

BLAW-KNOX ELECTROFORGED STEEL STAIR TREADS

Designed for tremendous strength against impact. Available with rolled diamond checker plate nosing (illustrated); twisted crossbar nosing; or abrasive nosing.

BLAW-KNOX ELECTROFORGED STEEL GRATING



The New Model 4 PILOT PIPE CUTTER for Asbestos—Cement and Clay Pipe

—Easy to Use Saves time and money

Pays for itself on the job. Simply drop on to the pipe, snap one point together . . . and you are cutting pipe—fast. There's always another handle within easy reach. Stays sharp ...up to 1000 cuts per blade sharpening.

Model 4—Basic Unit Range 3⅜"—8" O.D.

Wide Range: The basic unit of the Pilot Pipe Cutter handles all classes of 3", 4" and 6" pipe (3⅜" through 8" O.D.) Range can be increased up to 20" pipe in all classes (25" O.D.)
Light weight: just 16 pounds.

$56 freight added

Handle assemblies for increasing capacity . . . only $14.00

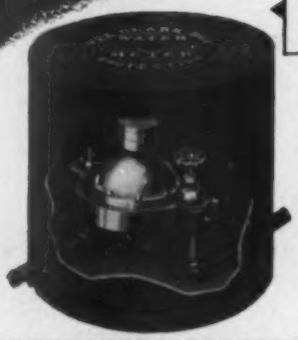
NEW PILOT MACHINING TOOL
• Now you can machine Pressure Pipe in the field. Ask your supplier

At your supplier or:

PILOT Manufacturing Company
420 MARKET STREET · SAN FRANCISCO 11 · CALIFORNIA
Distributors Wanted • Write for Details

CLARK METER BOXES AND COVERS

Left, No. 16 Clark Wonder Lock Meter Box Round....16" and 18" diameters. Large 13" lid.



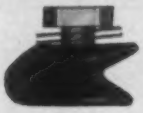
Above, No. 11 Oval Clark Wonder Lock Meter Box, especially for warmer climates. H-11", L-18", W-12".

Below, A-2-13 Clark Meter Box Cover with screw lock. Height 4", lid opening 13".

Above, A-2-11 Clark Single Lid Meter Box Cover, 4" throat. Also available in 6" and 9" throat.

Below, B-2-11-L Clark Double Lid Meter Box Cover, 6" throat. Also available in 4" and 9" throat.

Above, AA-3-12 Clark Meter Box Cover with 13" Wonder Lock Lid, for use with 15" (illustrated), 18" and 20" box body.



Improved Screw Lock with strong forged bronze bolt.

Wonder Lock Lid (bottom view) showing forged bronze bars.

Perfect Lock of one-piece manganese bronze forging.

write

H. W. CLARK CO.
MATTOON, ILLINOIS

hoe attachment in place of loader, or to a mobile 3-ton crane operating boom of 10 to 23 ft. length.

All loading operations are powered by standard hydraulic motors and pumps which eliminate numerous small parts and danger of breakage.

To obtain further information on this unit, use a Reader Service Card on which is entered the above key number and your name and address.

Rockwell Supervisor Appointments

Announcement has been made of the appointment of Dan R. Gannon as Water Meter Sales Supervisor in the Chicago area for the Pittsburgh Equitable Meter Division of Rock-

D. R. Gannon

J. W. Northcutt

well Mfg. Co. Mr. Gannon succeeds Ross Burns who was recently transferred to the Pacific Coast.

Announcement has also been made of the appointment of J. W. Northcutt as Atlanta District Sales Manager of Rockwell Mfg. Co. to succeed C. C. Moore who has been transferred to the company's new district office in Columbus. Mr. Northcutt was formerly located in the Houston office.

Ralph Thornburg Joins Marlow Pumps

Marlow Pumps, Ridgewood, N.J., has announced the appointment of

Ralph Thornburg as District Sales Representative for the East Coast, from metropolitan New York to Virginia. Mr. Thornburg was formerly with the Yale and Towne Mfg. Co. as Sales Manager of the Pump Division.

207

Industrial Water Filter

Oscar Fisher Co., Inc., New York City has developed a permanent element transparent water filter. The metallic filter element is composed of microscopic bronze spheres formed into a filter element by new metallurgical methods. It is not a metal screen in the usual sense. The

transparent case of plastic makes it possible to see dirt or foreign material removed from the water. The unit is easily cleaned, and has a capacity of 10 gal. per min.

To obtain further information on this unit, use a Reader Service Card on which is entered the above key number and your name and address.

A Winner of ENGINEER-PREFERENCE

Suited to handling of clear water and other low viscosity liquids not containing solids.

Water Supply • Water Booster for Upper Floors of Buildings • White Water and Overflow in Paper Mills • Condensation Return • Hot Well • Make-Up Water etc., etc.

Write for CONDENSED CATALOG "M"

Type AD Aurora Horizontally Split Case, Back to Back Impellers, Two Stage Centrifugal Pump.

Ready dismantling is provided by split-case design without disturbing suction or discharge. Water channels and impellers are hydraulically streamlined to insure smoothest flow. These are improved pumps built to specifications that will command your complete confidence — and confirm that confidence through faithful long-time performance. This member of the distinguished line of PUMPS "by Aurora" is available in capacities to 1200 G.P.M. and heads to 440 ft.

There is a Size and Type of PUMP "by Aurora" for Almost EVERY Pump Need in INDUSTRY

APCO TURBINE-TYPE PUMPS

For high pressure, small capacity requirements up to 150 g.p.m. Wide operating range characteristics. No metal-to-metal contact. Handles non-lubricating liquids without wear. Only one moving part — the impeller.

DISTRIBUTORS IN PRINCIPAL CITIES

AURORA Always PUMPS

AURORA PUMP COMPANY

48 Loucks St., Aurora, Ill.

Tegul-MINERALEAD* and HYDE-RO RINGS

An efficient way to join Cast Iron Bell and Spigot Pipe

The use of HYDE-RO RINGS with TEGUL-MINERALEAD is recommended by Atlas for best results. These two jointing materials are easy and clean to work with, economical, and require no skilled labor. For complete details on these two Atlas products, write us at 20 Walnut Street, Mertztown, Penna., requesting Bulletins No. M10-1 and M10-5.

Suppliers of G-K, the original hot poured bituminous Sewer Joint Compound, and ATLAS-TIC 77, ready mixed cold trowel type Sewer Joint Compound. Special bulletins available upon request.

THE ATLAS MINERAL PRODUCTS COMPANY

MERTZTOWN, PENNA. HOUSTON, TEXAS

*Trade Mark Registered

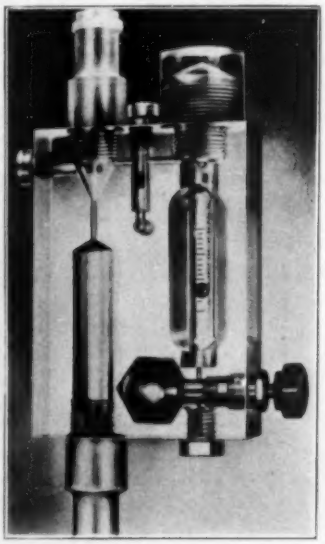
Hays Mfg. Co. Holds Unique Sales Meeting

Hays Mfg. Co., Erie, Pa. held a most unique sales conference at Honey Harbor, Georgia Bay, Ontario. Mornings were devoted to conferences and the afternoons to fishing and recreation as shown by the accompanying photograph.

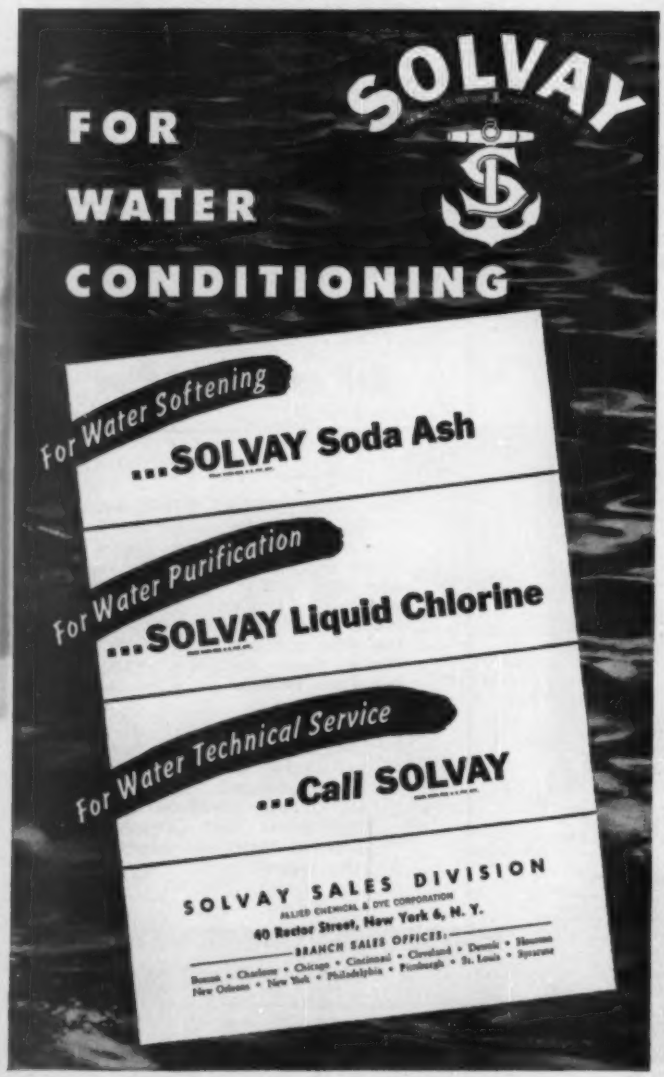
208

Compact Chemical Feeder

Fischer & Porter Co., Hatboro, Penna., has developed a self-contained chemical feeder. Known as the "Feed-Rator" and made of transparent acrylic plastic, this unit simultaneously controls, meters and dispenses relatively small amounts of bactericides, catalysts, disinfectants, and other reagents. The built-in eductor takes the place of a pump and many highly corrosive chemicals can therefore be fed directly from a container. The unit will treat up to 7000 gal. per day of water directly. In a bypass arrangement, using a solution containing 5 per cent active reagent, by weight, 14 mgd. can be treated with 5 ppm. of reagent.



To obtain further information on this new unit, use a Reader Service Card on which is entered the above key number and your name and address.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WATER
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SOLVAY
For Water Softening
...SOLVAY Soda Ash
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BRANCH SALES OFFICES
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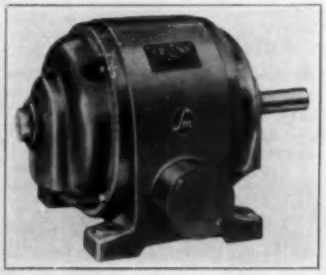
New Orleans • New York • Philadelphia • Pittsburgh • St. Louis • Syracuse

209

Splash-Proof Motor

Sterling Electric Motors, Inc. of Los Angeles has recently introduced a new Splash-Proof motor designed for locations which are subject to direct streams of water or other liquids. The motor may be mounted in any position and still keep its



splash-proof features. The end bells permit free passage of ventilating air through integrally-cast baffles, which prevent splashing liquids from reaching the interior of the motor. Air is drawn through the rear of the motor and exhausted through the shaft end.

For further information on this new splash proof motor use a Reader Service Card on which is entered the above key number and your name and address.

LITERATURE AND CATALOGS

210
RACK RAKE

Newport News Shipbuilding and Dry Dock Co., Newport News, Va., has issued a bulletin on the Newport News Mechanical **Rack Rake.** The bulletin describes the Rack Rake which is a power operated rake for cleaning trash racks at water intakes, pumping stations, canals, hydroelectric and steam plants. It cleans rack bars of trash such as leaves, grass, sticks, bark, and logs, thereby reducing a former major hand operation to one of minor period power activity.

The bulletin describes the rake, shows pictures of its construction and shows the effectiveness of installations. Typical arrangements are also shown.

To obtain a copy of this interesting bulletin on the Rack Rake, use a Reader Service Card on which is entered the above key number and your name and address.

211
MONEY SAVING METALLIZING

The November issue of the **METCO NEWS** reports that users of metallizing have found rebuilding fits of all kinds a great money and time saver. For instance, one large company reports real money-saving on motor blower end-plates. In operation, the press fit is often lost and must be restored. Cost of a new plate is $20. With metallizing, the entire operation—including preparation, spraying and finishing takes less than an hour, at a cost of $1.35 each. Savings—about $18.50 an end plate. Furthermore some of these metallized end plates have been in service five years and are still good, whereas, new plates last about a year only.

M & H

HYDRANTS, VALVES & PIPE LINE ACCESSORIES

Hub Ends, Mechanical Joints, Flanged or Screwed.

Write for Catalog No. 34

VALVES: A.W.W.A. type iron body, bronze mounted with double-disc parallel seat or solid wedge type. Non-rising stem, outside screw and yoke, or with sliding stem and lever. Also furnished hydraulically operated. Square bottom type operates in any position.

HYDRANTS: Standard A.W.W.A. type approved by Underwriters and Factory Mutuals.

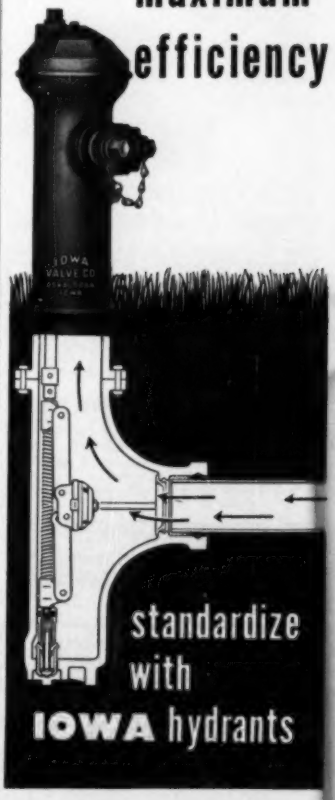
LEFT:
HYDRAULIC GATE VALVE
For quick and easy operation by remote control.

M & H PRODUCTS INCLUDE

FIRE HYDRANTS
GATE VALVES
TAPPING VALVES
WALL CASTINGS
SPECIAL CASTINGS
TAPPING SLEEVES
CHECK VALVES
FLOOR STANDS
EXTENSION STEMS
SHEAR GATES
MUD VALVES
VALVE BOXES
FLAP VALVES
SLUDGE SHOES
FLANGE AND FLARE FITTINGS
FLANGED FITTINGS
B & S FITTINGS
CUTTING-IN TEES

M & H VALVE AND FITTINGS COMPANY
ANNISTON, ALABAMA

for maximum efficiency



standardize with IOWA hydrants

Two piece operating nut with special adjustment screw solves the problems of expansion and contraction . . . makes Iowa hydrants easy to operate at all times.

Positive operating mechanical drain valve can be removed along with all other working parts through top of hydrant without special tools.

Fixed position of valve arms makes leaking impossible should standpipe be broken.

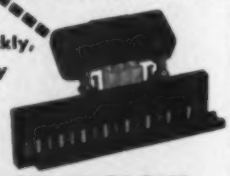
Unrestricted water flow gives full pressure at extreme low loss of head.

Built to conform to the latest A.W.W.A. specifications.

IOWA VALVE COMPANY
201-299 N. Talman Avenue • Chicago 80, Illinois
A subsidiary of James B. Clow & Sons

on the spot CHLORINE DETERMINATIONS

made quickly, accurately with a



TAYLOR-ENSLOW SLIDE CHLORIMETER

The ideal instrument for determining the free or residual chlorine content of water, sewage or industrial wastes.

Taylor-Enslow slides are molded of durable plastic and contain a complete set of 9 sealed color standards. Two slides are available: 0.0 to 1.0 p.p.m. and 0.0 to 3.0 p.p.m. of chlorine. All Taylor liquid color standards carry an unlimited guarantee against fading. Combination pH and Chlorine sets, and complete Taylor Water Analyzer sets are also available. All sets are easily portable.

READ THIS INFORMATIVE BOOK

Write direct for "Modern pH and Chlorine Control" . . . gives valuable data for all water and sewage operators . . . describes Taylor outfits. See your dealer for equipment.

W. A. TAYLOR AND CO.
2108 YORK RD. • BALTIMORE 4, MD.

NEW APPLICATIONS FOR HELLIGE COMPARATORS

ORTHO-TOLIDINE-ARSENITE TEST

DETERMINATION OF

FLUORIDE AND BROMINE

WRITE FOR DETAILED INFORMATION

HELLIGE
INCORPORATED
3718 NORTHERN BLVD., LONG ISLAND CITY 1, N.Y.

Another user tells of rebuilding a 30-in. spindle with three different bearing race diameters — 3.25-in., 3.625-in., and 3.875-in. The surfaces were sprayed with 0.10 carbon steel, 0.030-in. on a side and machine finished. New spindles cost $110.00—total cost of the metallizing job was $2.75 or about 3 per cent of the cost of a new spindle.

There are numerous applications for metallizing around water and sewage works. During the war this process proved a life-saver. To obtain a copy of Metco News, Vol. 4 No. 11 use a Reader Service Card on which is entered the above key number and your name and address.

212
MECHANICAL SEALS FOR CENTRIFUGAL PUMPS

Byron Jackson Co., Los Angeles 54, Calif. has issued a new 12-page illustrated bulletin describing the three types of **BJ Mechanical Seals** for centrifugal pumps. These BJ Mechanical Seals are designed for sealing stuffing boxes in centrifugal pumps handling hot or cold liquids, either corrosive or noncorrosive.

To obtain a copy of this bulletin use a Reader Service Card, on which is entered the above key number and your name and address.

213
BRONZE GATE VALVE

The Kennedy Valve Mfg. Co., Elmira, N.Y., has issued a full description of the Fig. 27, and Fig 30 line of **Standard Bronze Gate Valves.** Design features of the two valves are explained in detail with a large sectional drawing of a valve providing easy visual reference. Service ratings and a comprehensive table of sizes and dimensions are included.

214
WATER CONDITIONING

Graver Water Conditioning Co., New York, has outlined its products services, and background in a bulletin titled **Water Conditioning Processes and Equipment.** The bulletin explains the scope of Graver activities in the fields of water conditioning, boiler plant waters, process work and general industrial and municipal uses. The bulletin is illustrated by some of the company's large installations of hot process, zeolite softeners, demineralizers, clarifiers, filters.

To obtain a copy of this bulletin on water conditioning processes and equipment, use a Reader Service Card on which is entered the above key number and your name and address.

CONTROL *Gas Pressures*

From Digestion Tanks with NORWALK REGULATORS and CHECK VALVES

Handling sewage gas from digestion tanks is one of Norwalk Valve's activities in the manufacture of gas pressure control equipment. Stock items include check valves, pressure relief valves, regulators, all sizes and pressures. Illustrated are the Norwalk Disc Check Valve and the "Meter Cop" (a Norwalk exclusive).

DESIGN AND FABRICATION OF SPECIAL UNITS

Any unusual problems can be solved by our design and fabrication of special units. Norwalk products are made with ASTM and other materials required by contract specifications.

Outline your requirements in a note to us. We'll be glad to suggest designs and special equipment. We'll also send along a catalogue of our complete line of gas control equipment.

NORWALK VALVE COMPANY
33 RAILROAD AVENUE
SOUTH NORWALK, CONN.

Phipps & Bird
LABORATORY MIXER

is the important piece of equipment in the Modern Water Works Laboratory. Now being used by leaders in water works research. Many superintendents and chemists have been able to reduce their chemical costs by the control of chemical dosages with this mixer. Write for literature.

PHIPPS & BIRD, INC. Richmond, Va.

DARLEY MAGNETIC DIPPING NEEDLE $17.50

with 3 section telescoping handle $22.25

Write Today for 68-Page Catalog

W. S. DARLEY & CO., Chicago 32

215

BLOWERS AND EXHAUSTERS

Roots-Connersville Blower Corp., Connersville, Ind., has just published a completely revised 24-page booklet in two colors covering its **Centrifugal Blowers and Exhausters.** The bulletin reviews the company's experience in designing this type of unit and devotes several pages to the design and construction of single stage units, with illustrations of various types. Another six pages is given to discussion and illustration of multi-stage units. A 2-page spread is used covering the subject of regulation, and "R-C dual-ability" is discussed in the closing pages of the book.

To obtain a copy of this informative booklet on the centrifugal blower and its advantages, use a Reader Service Card on which is entered the above key number and your name and address.

216

POSEY IRON WORKS

The Posey Iron Works, Inc., formerly the Lancaster Iron Works, Inc. of Lancaster, Pa., has issued a bulletin on the Posey plant. The bulletin shows the various types of equipment made by the Posey Co., in its steel plate division and its machine shop, brick machinery div., foundry, industrial heating div., steel form div., and shipbuilding div.

To obtain a copy of this bulletin and learn more about the Posey Iron Works, use a Reader Service Card on which is entered the above key number and your name and address.

217

FLOCCULATION

The Chain Belt Co., of Milwaukee has available a bulletin on **Rex Flocculation Equipment.** This bulletin shows the "Rex Floctrol" designed to improve mixing, save chemicals and increase plant efficiency. The bulletin shows the "Floctrol" design, arrangement, and tank. Pictures are shown of the installation of the unit and a discussion is given of the features which lead to long life and economical operation. The 2-page spread shows typical arrangements in diagram to indicate the flexibility which can be obtained from the equipment. This equipment is also usable in industrial waste treatment.

To obtain a copy of this bulletin on the "Floctrol," use a Reader Service Card on which is entered the above key number and your name and address.

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218

SEWER CLEANING EQUIPMENT

Flexible Sewer-Rod Equipment Co., Los Angeles 34, Calif., has issued a 36-page bulletin on **Flexible Sewer Cleaning Equipment.**

The bulletin shows pictures of operations of this equipment, of all of the types of tools used, sizes of roots which have been removed, means of carrying the equipment, power-drive, water power cleaning units, brushes, appurtenances, rubber pipe plugs, line pullers, winches, gouger blades, pipe scrapers and all

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TABLES OF COMPARATIVE QUANTITIES

Nominal Inside Dia. of pipe, In.	Depth of Joint, Inches Lead	Approx. Lbs. Leadite per joint	Depth of Joint, Inches Leadite	Approx. Lbs. Leadite per Joint
4	2.5	2.00	2.25	8.56
6	2.5	3.00	2.25	11.71
8	2.5	4.00	2.25	14.63
10	2.5	5.00	2.25	17.70
12	2.5	6.00	2.25	20.86
14	2.5	7.00	2.25	24.02
16	2.5	8.25	2.25	33.07
18	2.5	9.25	2.25	36.88
20	2.5	10.50	2.25	40.71
24	2.5	13.00	2.50	53.02
30	2.75	16.00	2.50	65.36
36	2.75	19.00	2.50	77.96
48	3.50	30.00	3.00	121.15
54	4.0	38.00	3.00	135.60
60	4.0	42.00	3.00	150.70

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To obtain a copy of this bulletin, use a Reader Service Card on which is entered the above key number and your name and address.

219
DETECTOR WATER METER

The Hersey Manufacturing Co., Cor. E and 2nd Sts., South Boston, Mass., has available a 4-page folder catalog showing the **Hersey Detector Water Meter.** Pictures of the meter are shown, both external and internal views, and a complete description of Model FM is given.

To obtain a copy of this bulletin, use a Reader Service Card on which is entered the above key number and your name and address.

220
SEWAGE SAMPLERS

Infilco Inc., Chicago, Ill., has available a new bulletin on **Sewage Samplers.** This bulletin shows an automatic sewage sampler which produces truly representative samples. It shows details of the unit and the typical installation and describes its use and operation.

To obtain a copy, use a Reader Service card on which is entered the above key number and your name and address.

221
CONTROL INSTRUMENTS

Fischer & Porter Co., Hatboro, Pa., has issued a new catalog on Instruments and Controls. This catalog shows a wide variety of primary and secondary flow instruments and control valves for all industries. The catalog contains 24 pages and is illustrated with pictures of all types of equipment manufactured by the company. Also covered in this catalog is the pneumatrol, air-operated control mechanism and the company's lines of valverator air-operated diaphragm motor valves.

To obtain a copy of this catalog, use a Reader Service Card on which is entered the above key number and your name and address.

222
INDUSTRIAL WASTE TREATMENT

A recent issue of *Modern Precision* published by Leeds & Northrup Co., Philadelphia, Pa., has a complete story on industrial waste treatment. It is titled "The Micromax Automatic pH Control Guides Novel 4-Way Waste Neutralization Systems." This story tells the use of a micromax automatic

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pH control unit in a synthetic fibre plant which has sanitary sewage, sulfide waste, alkaline waste, and acid waste. The story should be of particular interest to persons dealing with the control of acid and alkaline industrial waste.

To obtain a copy of this story, use a Reader Service Card on which is entered the above key number and your name and address.

223

BANTAM PUMP

The Jaeger Machine Co., Columbus, Ohio, has available a 6-page folder on the Jaeger Bantam Pump. This pump which will deliver up to 5700 gallons an hour is useful for dewatering sumps, tanks, conduits or what have you.

To obtain a copy of this bulletin, use a Reader Service Card on which is entered the above key number and your name and address.

224

PAPER WASTE TREATMENT

The National Council for Stream Improvement of the Pulp, Paper and Paperboard Industries, Inc., has made available a reprint from the North American review number of **Pulp & Paper.** This article deals with the activities and expenditures of the pulp and paper industry in connection with stream improvement.

If you are interested in learning more about the operation of the National Council and of the work being done on the study and treatment of pulp and paper waste, use a Reader Service Card on which is entered the above key number and your name and address.

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225

CAVITATION IN HYDRAULIC TURBINES

Allis-Chalmers Co., Milwaukee, has recently published a 12-page bulletin on **"Prevention and Reduction of Cavitation and Pitting in Hydraulic Turbines."** Written by W. J. Rheingans, Asst. Mgr. of the company's Hydraulic Department, the bulletin explains and discusses cavitation in water as it applies to hydraulic turbines. Applicable basic formulas are elaborated upon and the relative merits of avoiding cavitation or minimizing its effects are presented. Examples of pitting are given and methods of preventing pitting are discussed.

This topic of cavitation and pitting is of interest not only to operators of hydraulic turbines but also to operators of water and sewage pumps.

To obtain a copy of this bulletin, use a Reader Service Card, on which is entered the above key number and your name and address.

226

LABORATORY MIXER

Stuart Corp., Baltimore, Md., has issued a 4-page folder on a **Procedure for Running a Jar Test.** The folder shows a six-unit laboratory jar test stirrer; describes how a stirring machine operates; the apparatus required; and the procedure for making a jar test to improve chemical coagulation of water.

To obtain a copy of this bulletin, use a Reader Service Card on which is entered the above key number and your name and address.

227

COMBUSTIBLES RECORDER

Bailey Meter Co., Cleveland 10, Ohio, has published a new **Bailey Combustibles Recorder** bulletin. Drawings and photographs explain the operation of this electronic type

36 WORDS ABOUT SEWAGE TREATMENT 36

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of instrument which operates on a catalytic combustion principle. Typical applications to various types of furnaces and boilers are shown.

To obtain a copy of this bulletin, use a Reader Service Card on which is entered the above key number and your name and address.

228

BLOWERS AND EXHAUSTERS

The Allen Billmyre Div. of Lamson Corp., Syracuse 1, New York, has recently issued a bulletin on the **Allen Billmyre Blowers and Exhausters.** This 4-page bulletin describes a centrifugal type blower as well as the heavy duty cast iron, multi-stage single steel blowers. Complete information on each of the types of the blowers is included in the bulletin.

To obtain a copy of this bulletin use a Reader Service Card on which is entered the above key number and your name and address.

229

IMPINGEMENT AERATOR

Walker Process Equipment Inc., Aurora, Ill., has available a 4-page folder on the **Diffusair,** the impingement aerator for aeration of water and sewage. The bulletin consists of diagrams showing the installation of this type of equipment and the results obtained therefrom.

To obtain a copy of the bulletin, use a Reader Service Card on which is entered the above key number and your name and address.

230

SHOCK ABSORBER

R-S Products Corp., Philadelphia 44, Pa., has issued a 2-page folder on the **R-S Heyden Liquid Shock Absorber.** This folder describes the compact shock absorber and excess pressure eliminator. Also shown are four different designs for domestic, industrial, dual, and super use. This device has been designed to eliminate hydraulic shock and hammering in pipe-line systems, reduce possibility of leaky joints, the opening of pipe seams, and to relieve pressure on valve packings.

To obtain a copy of this folder, use a Reader Service Card on which is entered the above key number and your name and address.

231

CATCH BASIN CLEANER

Netco Div., the Clark-Wilcox Co., Boston, Mass., has issued a 4-page folder on the **Netco Catch Basin Cleaner** with pneumatic control.

Sewer departments troubled with the problems of catch basin cleaning will find this equipment of interest for doing the job. The folder shows the device in use, describes its features and gives its specifications.

To obtain a copy of this folder, use a Reader Service Card on which is entered the above key number and your name and address.

232
BAR SCREEN

Link-Belt Co., Philadelphia, Pa., has issued a 4-page folder on the **Link-Belt Thru-Clean Bar Screen.** This folder shows a diagram of how the screen works; cutaway pictures of the screen in use, installed and in operation; and describes its operation for efficient removal of trash or large solids from water, sewage, and industrial waste.

To obtain a copy of this bulletin on this new equipment, use a Reader Service Card on which is entered the above key number and your name and address.

233
WATER CONDITIONING

Elgin Softener Corp., Elgin, Ill., has just released a new bulletin titled **Elgin Water Conditioning.** The bulletin contains complete up-to-date information on the design and application of water conditioning equipment, including zeolite water softeners, water treating chemicals, water conditioning systems for boilers and processing, water softener modernization, zeolites, filters, taste and odor removers and aerators. Also shown is an improved softener which delivers up to 44 per cent more soft water per regeneration of zeolites.

To obtain a copy of this new bulletin, use a Reader Service Card on which is entered the above key number and your name and address.

234
SEWAGE AND INDUSTRIAL WASTE PUMPS

Worthington Pump and Machinery Corp., Harrison, N.J., has issued a bulletin on the **Worthington Freflo Pumps,** for pumping sewage and industrial waste. The 12-page bulletin shows sections of and describes the horizontal type FL centrifugal pump, vertical long coupled centrifugal sewage pump, the close coupled centrifugal sewage pump and the vertical FLV pump. Performance curves are shown for all of the "Freflo" pumps.

To obtain a copy of this useful bulletin, use a Reader Service Card on which is entered the above key number and your name and address.

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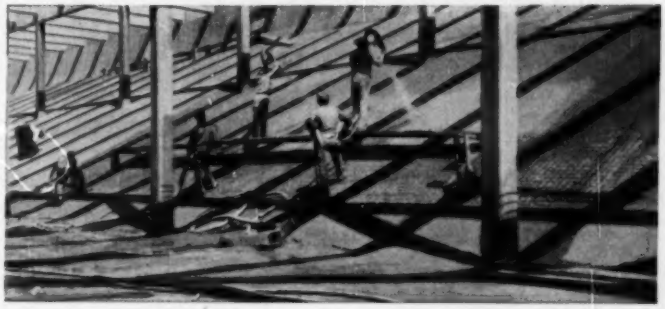

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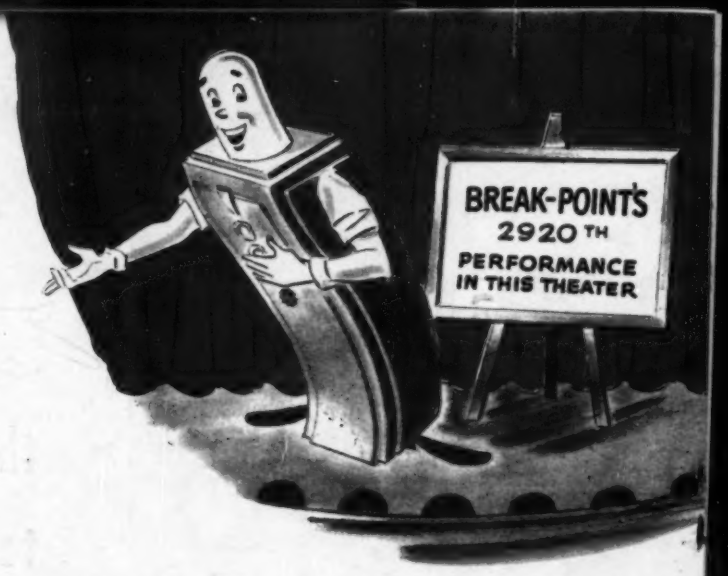

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